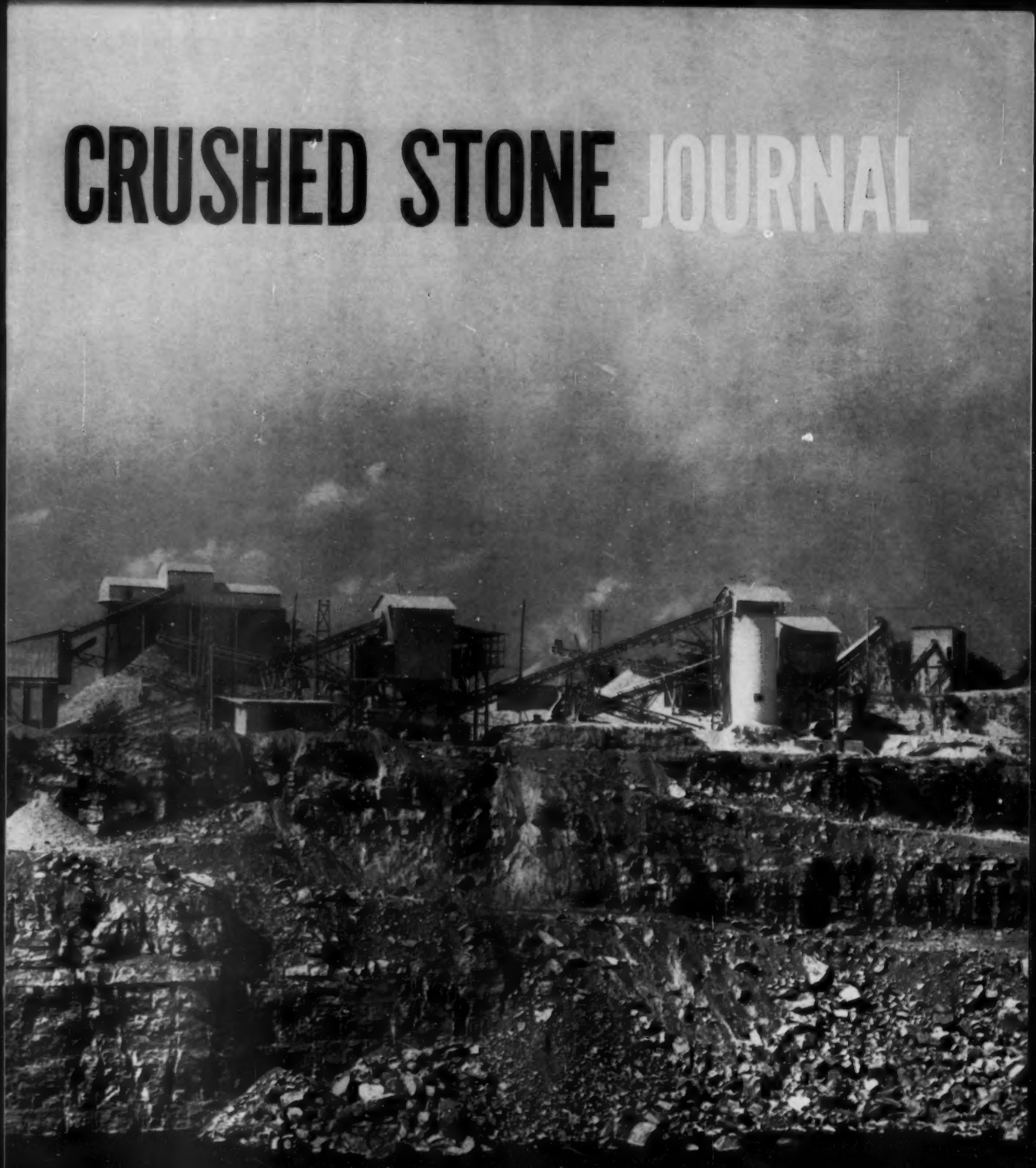
CRUSHED STONE JOURNAL



SEPTEMBER 1959

OFFICIAL PUBLICATION OF THE NATIONAL CRUSHED STONE ASSOCIATION

Congratulations to the Winners of the NCSA Safety Contest

The National Crushed Stone Association wishes to extend its heartiest congratulations to the winners of the NCSA Safety Contest.

The crushed stone industry can well take pride in the accomplishments of the 33 plants which operated 2,415,566 man-hours during 1958 without a disabling work injury.

Appropriate awards will be presented at the NCSA Annual Convention to be held February 22-24, 1960, at the Conrad Hilton in Chicago, Illinois.

The value of the Safety Contest is measured to a large degree by the number of participants. Plan now to enter your company's plants in the 1960 contest. Full details may be obtained by contacting the Branch of Accident Analysis, Division of Safety, U. S. Bureau of Mines, Washington 25, D. C.

Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

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Coming . . .

February 22-24, 1960

MANUFACTURERS DIVISION EXPOSITION

EQUIPMENT ON PARADE

The Manufacturers Division of NCSA offers to quarry operators an exceptional opportunity to view first hand, the newest developments and latest techniques in machinery, equipment, and supplies used in the production of crushed stone

at the . . .

43rd ANNUAL CONVENTION

of the

NATIONAL CRUSHED STONE ASSOCIATION

Conrad Hilton, Chicago, Illinois • February 22-24, 1960

Aggregates for Runway Pavements[1]

By J. E. GRAY

Engineering Director
National Crushed Stone Association
Washington, D. C.

AT ONE time aggregate was thought to be an inert filler and even now the American Society for Testing Materials definition gives it that connotation: "Aggregate—In the case of materials of construction, designated inert material which when bound together into a conglomerated mass by a matrix forms concretes, mastic, mortar, plaster, et cetera." It is well known that aggregates are not inert, that they possess many characteristics which must be evaluated in order to assure the best performance of a structure. The term aggregate is so encompassing that to limit the subject under discussion it will be confined essentially to coarse aggregate which is material larger than a No. 4 or No. 8 sieve.

Since a great deal of research has been conducted and experience gained on performance of aggregates in highway construction, it may be well to first review a typical specification for aggregate for portland cement concrete paving, to state the performance expected of concrete runways, and then to discuss the probable modification of the usual requirements to assure satisfactory performance.

Let ASTM C 33-57, Standard Specifications for Concrete Aggregates, be taken as typical. The essential requirements are: Coarse aggregate shall consist of crushed stone, gravel, or air-cooled iron blast furnace slag, or a combination thereof, conforming to the requirements of these specifications for grading, deleterious substances, soundness, and abrasion.

Grading

These specifications permit the engineer to select the proper grading specifications from a table of gradations covering a range in maximum size from 1/2 to 3 1/2 in., which gradings are in conformity with the U. S. Department of Commerce Simplified Practice Recommendation R 163-48. Last year the Bureau of Public Roads made a study of state highway specifications with respect to their conformity with these standard simplified practice sizes, with the indications that their size requirements were in general agreement with the Simplified Practice Recommendation. It may, therefore, logically be inferred that aggregates from established sources are being produced with gradations essentially in agreement with these simplified practice sizes. The grading specifications of some government agencies are not in conformity with these standard sizes and yet their departure is not great. It may be possible that considerable economy could be effected without any sacrifice of quality by having the gradation requirements in conformity with the simplified practice sizes or the local state highway department specifications.

The limitation on deleterious substances in the ASTM Standard Specifications C 33 is as follows:

Item	Maximum Per Cent by Weight of Total Sample
Clay lumps	0.25
Soft particles	5.0
Chert that will readily disintegrate (soundness test, 5 cycles)	1.0
Material finer than No. 200 sieve	1.0
Coal and lignite	1.0

Also the specifications state that the coarse aggregate shall not contain "any materials that are deleteriously reactive with the alkalies in the cement in an amount sufficient to cause excessive expansion." Time will not permit a discussion of the alkali-aggregate problem except to say that knowledge has been gained to the point that potentially reactive aggregates may be satisfactorily used, provided a laboratory investigation is made to indicate the properties of the cement which would provide for concrete without excessive expansion characteristics or the use of admixtures which would inhibit excessive expansion.

The soundness requirements of C 33 are that coarse aggregate subjected to 5 cycles of the soundness test shall have a loss not greater than 12 per cent when sodium sulfate is used or 18 per cent when magnesium sulfate is used. There are two "escape clauses": one, the coarse aggregate failing to meet the above requirements may be

[1] Presented at United States Air Force Conference, Berkeley, Calif., July 28, 1959

used provided it has a satisfactory service record, and two, coarse aggregate failing to meet the above requirements and not having a demonstrable service record may be used provided it gives satisfactory results in concrete subjected to a freezing and thawing test.

Coarse aggregate tested by the Los Angeles abrasion test shall have a loss of not more than 50 per cent, except that coarse aggregate with a greater loss may be used provided the aggregate produces satisfactory strengths in concrete of the proportions selected for the work.

Range in State Highway Specifications

A review of state highway department specifications shows a range in sodium sulfate soundness requirements for crushed stone of 1 per cent loss in 10 cycles to 15 per cent loss in 5 cycles, and a range in Los Angeles abrasion loss of 35 to 65 per cent.

Criteria of Performance for Runways

A modern concrete runway must be designed to carry the heavy loads of modern aircraft operating in a channelized pattern without cracking or any surface disintegration and must possess high skid resistance. The Air Force and the Corps of Engineers have agreed on a definition of failure which is that one crack in a pavement slab is considered failure. The quality requirements for aggregate to assure the best in economy and performance must be re-evaluated in light of these criteria because the requirements for satisfactory performance in highways are far more lenient than for runways, especially runways for operation of military aircraft.

Deleterious Materials

There can be no loose fragments of aggregate or mortar on the surface at any time that might be drawn into the intake airstream of a jet and cause serious damage to the engine. This requirement means that the aggregate must be free of unsound material which may cause surface pitting or pop-outs. The prime causes of pop-outs are shale, laminated limestone containing expansive clays, soft sandstone, low specific gravity chert, and mud balls. When such materials become frozen in a saturated condition they increase in volume with development of sufficient pressure to break out a sizeable piece of the surfacing mortar. Observations have been made of a pavement subjected to one winter of freezing and thawing in a mid-western state in which the coarse aggregate contained 1 to 1 1/2 per cent of unsound chert. The surface was badly marred with pop-outs which loosened discs of mortar 3 to 4 in. in diameter. At the bottom of each disc was a small piece of chert. It would thus appear that for the best performance the aggregate should be free of all unsound particles, or at least a reduction is indicated in the allowable amount of deleterious material in aggregate for runway construction under that permitted for highways.

Soundness

Soundness is the ability of an aggregate to resist excessively large and permanent changes in volume when subjected to the destructive agencies of weathering, the most essential one of which is resistance to freezing and thawing in a wet condition. Years ago, the sodium sulfate test was thought to simulate freezing and thawing on a much accelerated scale and has been, and still is, being used by numerous state highway departments to evaluate the durability of aggregate. However, there is poor correlation between the sodium sulfate test and performance in service. Certain aggregates with extremely fine pore structure show almost no loss in the sulfate test, but, when saturated in concrete and frozen, cause disintegration while, on the other hand, some highly porous aggregates fail badly in the sulfate test but perform satisfactorily in concrete. According to theories on soundness advanced by Powers, this performance in concrete is logical and emphasizes the fact that the sodium sulfate test does not agree in theory or fact with performance in service. Research studies made in the National Crushed Stone Association Laboratory confirm that there is no correlation between the two tests.

In the NCSA Laboratory a rather simple test is made to detect whether a rock is potentially unsound due to its sub-microscopic pore structure. Cores 2 in. in diameter are drilled from the rock and the ends are ground plane to a height of 2 in. They are then vacuum saturated, subjected to freezing and thawing, and the dilation or increase in length is measured. If the dilation is considered excessive, a graded aggregate sample is prepared and is incorporated in air entrained concrete and tested for durability by a freezing and thawing test.

There is no accepted standard method of test by freezing and thawing that gives results in sound-

ness that is indicative of performance in service because none of the present methods answers the question posed by Powers: "How long can the individual rock particles in a given class of air entrained concrete be continuously exposed to moisture and to periodic freezings without reaching critical saturation?" Critical saturation is that saturation under which dilation takes place with freezing and theoretically is more than 91.7 per cent of complete saturation. The problem is involved so that at the present time about the best that can be suggested on evaluation of soundness of aggregate is to incorporate it in air entrained concrete and test the concrete for resistance to freezing and thawing with due consideration being given to the rate of freezing, the amount of soaking, and to an interval of drying. In any event, the sodium or magnesium sulfate test is not reliable enough to indicate the suitability of an aggregate for runway pavements.

Los Angeles Abrasion Test

The Los Angeles abrasion test is used extensively to measure the quality of an aggregate with respect to its resistance to impact and grinding. Its usefulness in evaluating the concrete making properties of an aggregate have been summarized by Sweet as indicative of (a) strength properties of concrete in which the mix is rich enough so that the aggregate strength is an important factor, and (b) breakdown of aggregate causing degradation changes during mixing. Tests by Woolf show a range in modulus of rupture from about 880 psi with stone having a Los Angeles abrasion loss of 20 per cent down to 640 psi with stone having a Los Angeles abrasion loss of 60 per cent. Similar results have been obtained by North Carolina and Texas, and by the NCSA Laboratory. It would appear, therefore, that a requirement for Los Angeles abrasion loss should be a part of the specifications for aggregate for runways in order to obtain aggregate that will contribute to the flexural strength of the concrete, even though the aggregate should be tested in concrete for its flexural strength characteristics.

Other Properties

The foregoing covers a discussion of the usual tests on aggregates for indicating their suitability for use in concrete pavements; but, there are other properties which must be evaluated before a sound selection can be made to assure the best in performance. These are (a) the effect of coarse aggregate on the flexural strength of concrete, (b) the effect of coarse aggregate on the volume change of concrete, and (c) the effect of aggregate on skid resistance.

Flexural Strength

A concrete pavement is subjected to constantly varying stress due to changes in moisture, to the daily cycle of temperature changes, and to the many applications of wheel loads. Investigations on concrete beams subjected to repeated loads indicated that concrete is subject to fatigue. If concrete is subjected to repeated flexural stress in excess of 55 per cent of its ultimate stress, it will fail in a relatively few thousand load applications, while on the other hand, if the stress is less than 55 per cent of its ultimate strength, the concrete will withstand an infinite number of load applications. Generally, the temperature stress and load stress should not exceed one-half the modulus of rupture. Recently comparative flexural strength tests were made on two coarse aggregates with the following results:

Coarse Aggregate	Cement Factors sacks per cu yd	Slump in.	Modulus of Rupture 28 day psi
A	7.1	3/4	730
B	7.1	3/4	580

Suppose repeated loads are applied which create a stress up to 350 psi. This stress in concrete A would be $350/730 \times 100 = 48$ per cent of its modulus of rupture, and in concrete B would be $350/580 \times 100 = 60$ per cent of its modulus of rupture. Concrete A could withstand an enormous number of repetitions of stress without failure while concrete B would fail with a relatively few repetitions of stress. What may be seemingly a small difference in flexural strength can be of significant importance in preventing failure of a concrete slab.

The question may well be asked as to what are these fundamental properties of coarse aggregate that influence the flexural strength of concrete, aside from the strength of the aggregate as indicated by the Los Angeles abrasion test. Kaplan concludes in his recent investigation that "the variations in the flexural strength of concrete were wholly due to variations in shape, surface textures, and modulus of elasticity of the aggregates." Since these properties of the coarse aggregate are

not readily known, the best method of evaluating them for any particular project is to make comparative flexural strength tests on concretes made with the particular aggregates involved.

Volume Change

In a speech at the Annual Meeting of the ASTM in June in Atlantic City, New Jersey, Commissioner Armstrong of the Bureau of Public Roads said "If we could make a concrete pavement which had no change in volume, we could furnish the motorist an ideal pavement . . . But with present day materials, we cannot obtain a concrete which is constant in volume." Volume change is, thus, one of the most important characteristics of concrete, for change in volume creates stress and this type of stress in itself can be the cause of cracking and failure of the concrete. The coefficient of thermal expansion of neat cement varies between 5.0 and 12.5 millionths per degree Fahrenheit. Thermal expansion of concrete is greatly influenced by type of aggregate used because of large differences in thermal properties of the various types of aggregates. Siliceous aggregates such as chert, quartzite, sandstone, and some highly impure limestones have thermal coefficients of expansion between 4.5 and 6.5 millionths per degree Fahrenheit, while the coefficients for purer limestones, basalt, granite, and gneiss have values between 1.2 and 4.5 millionths per degree Fahrenheit.

In order to control the cracking of slabs due to the thermal properties of the coarse aggregate, Andrews makes the following recommendations for slab length:

Type of Coarse Aggregate	Slab Length, ft
Granite and trap rock	25
Limestone and calcareous gravel	20
Siliceous gravel, 3/4 in. or less maximum size gravel, and slag	15

Of course, the perennial debate among highway engineers is "How far apart should expansion joints be placed?" The temperature on June 29 and 30 in Washington reached 100 and on an 11 year old concrete road in nearby Virginia, there were four blow-ups in a relatively short section. One of the blow-ups occurred in a section where the concrete was 9 in. thick and had 3/4 in. expansion joints every 60 ft. The other three blow-ups occurred in a section where the concrete was 10 in. thick and had 3/4 in. expansion joints at 120 ft

FIGURE 1
Blow-up Showing Concrete Raised From the Subgrade

intervals with 3 intermediate contraction joints spaced at 30 ft intervals. The coarse aggregate was siliceous gravel. While the highway engineer may debate the spacing of expansion joints, blow-ups on runways cannot be tolerated. Therefore, the characteristics of the coarse aggregate with respect to thermal expansion must be properly considered in the design.

Drying shrinkage is of importance in that it has a pronounced effect on slab warping or curling and the frequency of cracking. Hveem and Tremper state "The integrity and smoothness of the pavement can be prolonged if the characteristic shrinkage of concrete can be reduced."

Drying shrinkage of concrete is caused principally by the contraction of calcium silicate gel in the hardened water-cement paste when the moisture content of the gel is decreased. The more important factors that influence drying shrinkage are the water-cement ratio, the amount of paste in the concrete, the mix proportions, the mineral composition of the aggregate, and the maximum size of the aggregate. The grading and physical properties of the aggregate have an important effect on concrete shrinkage. A well graded coarse aggregate with a large maximum size has a low void content and consequently requires a relatively small volume of mortar to give the necessary workability. Drying shrinkage tests

FIGURE 2
Temporary Repair to Blow-Up

on concrete made in the NCSA Laboratory with a constant cement factor of 6 sacks per cu yd, a consistency of 2 to 3 in. slump, but with different maximum sizes of coarse aggregate were as follows:

Maximum Size of Aggregate	2 in.	1 in.	1/2 in.
Voids in coarse aggregate, per cent	39	41	44
Volume of mortar, per cent	52	58	69
Drying shrinkage, per cent, after 24 weeks exposure to laboratory air	.038	.055	.073

These data on drying shrinkage indicate the desirability of using as large a maximum size of aggregate as possible within keeping with the necessary restrictions of slab thickness and workability.

Skid Resistance

The skid resistance of runway surfaces has not been a problem of major proportions in the past because large planes landing at high speeds had variable pitch propellors which made use of the power of the engines to stop the plane. In order to stop a modern jet plane, generally reliance must be upon the braking system on the landing wheels and the frictional resistance of the runway surface. This has brought the problem of the development of the best in skid resistant runway surfaces to the forefront. More research is needed before assurance can be given as to just what kind of surface constitutes the best in skid resistance.

A great deal of study has been given to the problem of skid resistance of highway surfaces and it may be said that NCSA has been investigating the problem for about the past 5 years with some tangible accomplishments. Some facts have been well established with regard to aggregates and skid resistance. These are: certain carbonate rocks tend to polish rather quickly and develop a slippery surface. This is particularly true if the coarse and fine aggregates are of the same type. The hard, crystalline, igneous rocks with relatively high silica content do not polish quickly and are considered satisfactory skid resistant aggregates. Also, there are siliceous limestones which do not polish. A knobby surface with almost any aggregate will ultimately polish and result in a slippery surface. A fine sandpaper texture offers the best in a non-skid surface.

Most tests of skid resistance or determinations of coefficient of friction of road surfaces have been at speeds under 50 miles per hour. Skid resistance is of primary importance on wet surfaces; however, for effective skid resistance contact must be made by the tire with the pavement surface upon which there has been interposed only a very thin film of water. The question arises as to when the water film is sufficiently removed to permit intimate contact with planes landing at speeds much higher than those for highway traffic. Studies made in England indicate that for high speeds a rougher or more open surface texture is desirable in affording better squeegee action. Thus, it may be indicated that a coarser textured surface with, say, 3/8 in. crushed quartz, quartzite, granite, trap rock, or similar hard aggregate which does not polish may offer the best in skid resistance for the particular conditions involved.

Suggested Procedure for Better Performance

The natural inference from all of the foregoing is that for satisfactory performance only hard, sound, durable, high strength aggregates should be used. At first thought, this may seem to be rather idealistic and impractical. Available aggregates have to be used; consequently the indication is that the best aggregates available should be used. While it would be desirable to have aggregates free of all deleterious materials, this is impractical, so specification limits have to be established with some tolerance, but this tolerance

should be more restrictive for concrete runways than the current tolerances used in highway construction. Even the best available may not be good enough in some cases. It is my understanding that the Autobahn has performed well. In some parts of the Autobahn the Germans used an inferior aggregate for the concrete in the lower part and topped it with concrete made with trap rock. Apparently one course immediately followed the other because there was perfect bond between the two types of concrete. Would this idea not offer a sound economical method for obtaining the best in runway surfaces in those areas where suitable aggregates are not available?

Bituminous Pavements

The effect of aggregate characteristics on the performance of bituminous pavements is quite different from that of portland cement concrete pavements. However, time will not permit a full discussion of this subject; but there are some aspects of quality of aggregate with respect to performance in bituminous concrete that will be briefly discussed.

The degree of soundness of aggregate that is required for bituminous concrete is an unsettled question among engineers: some say that asphalt waterproofs the aggregate, hence soundness is not a problem, while others maintain that the aggregate should meet the same soundness requirements as those established for portland cement concrete. In all probability, aggregate which contains pores less than 0.005 mm in diameter and dilates causing unsoundness in portland cement concrete will perform satisfactorily in hot-mix, hot-laid bituminous concrete. The types of unsoundness in aggregate that are suspect are those which cause pop-outs: such as shales, cherts, and laminated limestones or sandstones. Shales and unsound laminated rock can generally be detected by the sodium sulfate test and unsound chert by the specific gravity test. The surface of a bituminous concrete has its asphalt coating quickly removed and the aggregate is then exposed to weathering. To avoid any pitting or pop-outs with resulting loose fragments on the surface, the aggregate must be essentially free of these deleterious materials.

A rather interesting idea with regard to quality of aggregate was recently expressed by an ASTM subcommittee of Committee D-4 on Road and Paving Materials which was to the effect that at present specifications permit aggregate with a Los Angeles abrasion loss of up to 50 for base courses and 40 for surface courses. The limit of 50 is too high a value for base courses because it might encourage a minimum of compaction in an effort to reduce fracture of the stone. A limit of 45 was suggested for bases with no change in the requirement for surfacing. This is practically a re-affirmation that the Los Angeles abrasion test gives results indicative of action under a roller or of performance in service. Tests in the NCSA Laboratory have shown a good correlation of loss in Los Angeles abrasion and the amount of crushing under a roller. The Los Angeles abrasion test is, therefore, a desirable test for measuring the quality of an aggregate relative to its performance in bituminous concrete.

The ability of an aggregate to retain its asphalt film in the presence of water has an important effect on the durability of a bituminous mix. If the asphalt film sloughs off the aggregate due to water being present and there are appreciable areas of the aggregate exposed, it is said to have stripped. A great deal of effort is being made to develop a stripping test that will give an indication of the performance to be expected in service. The two most widely used stripping tests are the immersion-compression test and the static immersion test. The immersion-compression test is a test to measure the effect of water on cohesion of compacted bituminous mixtures. It is an ASTM Standard Designation D 1075-54. In this test the relative strength is determined on specimens that have been stored in air and on similar specimens that have been stored in water for 4 days. The percentage reduction in strength of the specimens stored in water over those stored in air is an indication of the amount of stripping. Just how well this test gives results that are indicative of performance in service is open to question.

The static immersion test consists of mixing 100 grams of 1/4 to 3/8 in. aggregate with 5.5 per cent asphalt, immersing the mixture in distilled water for 18 hours, and then estimating whether the percentage of the aggregate surface remaining coated with asphalt is above or below 95 per cent. Our limited experience with this test is that not only is there no correlation, but the test may give misinformation. A sample of granite was sent to the NCSA Laboratory because it failed in the static immersion test. The test was repeated in the Laboratory and the sample stripped badly. However, this particular granite had a good service record.

(*Continued on Page 23*)

Awards of the 1958 National Crushed Stone Association Safety Contest

By ELIZABETH K. ELSNER

Under the Supervision of John C. Machisak
Chief, Branch of Accident Analysis, Division of Safety
United States Bureau of Mines
Washington, D. C.

THIRTY-THREE crushed stone plants will receive awards from the National Crushed Stone Association in recognition of their outstanding safety performance during the 1958 Safety Contest, conducted annually by the Bureau of Mines, U. S. Department of the Interior. This safety contest is designed specifically to stimulate crushed stone producers, through recognition of plants without disabling work injuries, to take greater interest in developing, implementing, and carrying on more effective accident prevention programs. It is conducted by the Bureau of Mines and sponsored by the National Crushed Stone Association. Furthermore, the same rules and the same reports are used in both the National Safety Competition and the National Crushed Stone Association Contest. There are two additional qualifications for the crushed stone contest, which are: The company must be a member of the Association and must produce crushed stone for commercial use.

All eligible plants, regardless of the number of operating days or man-hours worked, completing the first contest year without a disabling work injury, will receive the National Crushed Stone Association Safety Award. For each additional year up to 5 without a disabling work injury, the plant will receive green bars showing the year and man-hours worked; from 5 to 10 consecutive years, a silver bar; and for 10 or more consecutive years, a gold bar. Each employee of an injury free operation receives an individual safety award certificate. The plant with the greatest number of man-hours, without a disabling work injury in each contest group, will receive a bar showing the year, number of man-hours worked, and be designated the Group Winner.

The plant with the longest injury free period of operating time will receive the Explosives Engineer bronze plaque portraying in bas-relief the quarrying scene on the pedestal of the "Sentinels of Safety" trophy awarded in the National Safety Competition.

For purposes of making awards, the contest is divided into five man-hours groups, namely: Group I, plants working 200,000 or more; Group II, 100,000 to 200,000; Group III, 50,000 to 100,000; Group IV, 30,000 to 50,000; and Group V, 30,000 or less.

These 33 winning plants, each of which operated throughout 1958 with no disabling work injuries are classified into their respective man-hour groups as follows:

GROUP I PLANTS WORKING 200,000 MAN-HOURS OR MORE

Clinton Point quarry, New Hamburg, Dutchess County, N. Y., operated by New York Trap Rock Corporation, 336,330 man-hours

Krause No. 1 quarry, Columbia, St. Clair County, Ill., operated by Columbia Quarry Company, 233,316 man-hours

Tomkins Cove quarry, Tomkins Cove, Rockland County, N. Y., operated by New York Trap Rock Corporation, 219,359 man-hours

GROUP II PLANTS WORKING 100,000 TO 200,000 MAN-HOURS

North Branford No. 7 quarry, North Branford, New Haven County, Conn., operated by New Haven Trap Rock Company, 144,331 man-hours

Dan quarry, Martinez, Columbia County, Ga., operated by Superior Stone Company, 137,346 man-hours

Downington quarry, Downington, Chester County, Pa., operated by Bradford Hills Quarry, Incorporated, 114,233 man-hours

Pixley underground mine, Independence, Jackson County, Mo., operated by Stewart Sand and Material Company, 106,649 man-hours

TABLE I

Relative Standing of Quarries in the 1958 National Crushed Stone Association Safety Contest, Based Upon Injury-Severity Rates [1]

Rank	Man-hours worked	Injuries [1]					Average days of disability per temp. injury	Days of disability [1]					Frequency rate [2]	Severity rate [2]
		F.	P.T.	P.P.	Temp.	Total		F.	P.T.	P.P.	Temp.	Total		
1	336,330	—	—	—	—	—	—	—	—	—	—	—	0.000	0.000
2	233,316	—	—	—	—	—	—	—	—	—	—	—	.000	.000
3	219,359	—	—	—	—	—	—	—	—	—	—	—	.000	.000
4	144,331	—	—	—	—	—	—	—	—	—	—	—	.000	.000
5	137,346	—	—	—	—	—	—	—	—	—	—	—	.000	.000
6	114,233	—	—	—	—	—	—	—	—	—	—	—	.000	.000
8	95,203	—	—	—	—	—	—	—	—	—	—	—	.000	.000
9	81,878	—	—	—	—	—	—	—	—	—	—	—	.000	.000
11	68,657	—	—	—	—	—	—	—	—	—	—	—	.000	.000
12	62,920	—	—	—	—	—	—	—	—	—	—	—	.000	.000
13	62,124	—	—	—	—	—	—	—	—	—	—	—	.000	.000
15	57,032	—	—	—	—	—	—	—	—	—	—	—	.000	.000
16	47,718	—	—	—	—	—	—	—	—	—	—	—	.000	.000
18	46,777	—	—	—	—	—	—	—	—	—	—	—	.000	.000
19	43,998	—	—	—	—	—	—	—	—	—	—	—	.000	.000
20	38,457	—	—	—	—	—	—	—	—	—	—	—	.000	.000
21	38,422	—	—	—	—	—	—	—	—	—	—	—	.000	.000
22	34,918	—	—	—	—	—	—	—	—	—	—	—	.000	.000
24	32,652	—	—	—	—	—	—	—	—	—	—	—	.000	.000
25	30,932	—	—	—	—	—	—	—	—	—	—	—	.000	.000
26	28,222	—	—	—	—	—	—	—	—	—	—	—	.000	.000
27	26,400	—	—	—	—	—	—	—	—	—	—	—	.000	.000
28	23,000	—	—	—	—	—	—	—	—	—	—	—	.000	.000
29	22,672	—	—	—	—	—	—	—	—	—	—	—	.000	.000
30	19,762	—	—	—	—	—	—	—	—	—	—	—	.000	.000
31	16,800	—	—	—	—	—	—	—	—	—	—	—	.000	.000
32	12,195	—	—	—	—	—	—	—	—	—	—	—	.000	.000
33	11,640	—	—	—	—	—	—	—	—	—	—	—	.000	.000
34	63,226	—	—	—	1	1	1	—	—	—	1	1	15.816	15.816
35	79,415	—	—	—	1	1	3	—	—	—	3	3	12.592	37.776
37	46,553	—	—	—	1	1	3	—	—	—	3	3	21.481	64.443
38	131,044	—	—	—	1	1	9	—	—	—	9	9	7.631	68.679
39	580,488	—	—	—	4	4	10	—	—	—	41	41	6.891	70.630
40	176,000	—	—	—	3	3	5	—	—	—	15	15	17.045	85.227
41	58,500	—	—	—	1	1	5	—	—	—	5	5	17.094	85.470
42	257,550	—	—	—	1	1	26	—	—	—	26	26	3.883	100.951
43	110,549	—	—	—	3	3	5	—	—	—	14	14	27.137	126.641
44	72,488	—	—	—	2	2	5	—	—	—	10	10	27.591	137.954
45	38,852	—	—	—	2	2	3	—	—	—	6	6	51.477	154.432
46	24,000	—	—	—	1	1	4	—	—	—	4	4	41.667	166.667
47	108,276	—	—	—	2	2	10	—	—	—	19	19	18.471	175.477
48	46,564	—	—	—	1	1	9	—	—	—	9	9	21.476	193.282
49	197,290	—	—	—	8	8	5	—	—	—	40	40	40.549	202.747
50	133,114	—	—	—	4	4	7	—	—	—	29	29	30.049	217.858
52	66,491	—	—	—	1	1	17	—	—	—	17	17	15.040	255.674
53	72,048	—	—	—	1	1	19	—	—	—	19	19	13.880	263.713
56	141,888	—	—	—	1	1	47	—	—	—	47	47	7.048	331.247
57	195,553	—	—	—	1	1	68	—	—	—	68	68	5.114	347.732
58	71,332	—	—	—	2	2	15	—	—	—	30	30	28.038	420.569
59	19,571	—	—	—	2	2	5	—	—	—	9	9	102.192	459.864
60	55,548	—	—	—	1	1	26	—	—	—	26	26	18.002	468.064
61	96,286	—	—	—	4	4	12	—	—	—	48	48	41.543	498.515
62	130,200	—	—	—	2	2	34	—	—	—	68	68	15.361	522.273
63	61,860	—	—	—	2	2	20	—	—	—	40	40	32.331	646.621
64	180,315	—	—	—	9	9	13	—	—	—	119	119	49.913	659.956
65	24,300	—	—	—	1	1	17	—	—	—	17	17	41.152	699.588
66	24,809	—	—	—	2	2	9	—	—	—	18	18	80.616	725.543
67	135,350	—	—	—	3	3	35	—	—	—	104	104	22.165	768.378
68	26,247	—	—	—	2	2	11	—	—	—	21	21	76.199	800.091
69	79,741	—	—	—	2	2	42	—	—	—	84	84	25.081	1,053.410
71	139,221	—	—	—	2	2	82	—	—	—	163	163	14.366	1,170.800
73	72,673	—	—	1	—	1	—	—	—	100	—	100	13.760	1,376.027
74	45,727	—	—	—	2	2	33	—	—	—	65	65	43.738	1,421.480
75	31,686	—	—	—	2	2	25	—	—	—	50	50	63.119	1,577.984
76	61,158	—	—	—	5	5	23	—	—	—	115	115	81.755	1,880.375
77	65,340	—	—	—	1	1	125	—	—	—	125	125	15.305	1,913.070
78	27,916	—	—	—	1	1	55	—	—	—	55	55	35.823	1,970.267

(CONTINUED)

TABLE I

RELATIVE STANDING OF QUARRIES IN THE 1958 NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST, BASED UPON THE INJURY-SEVERITY RATES [1]—*Continued*

Rank	Man-hours worked	Injuries [2]					Average days of disability per temp. injury	Days of disability [2]					Frequency rate [3]	Severity rate [3]
		F.	P.T.	P.P.	Temp.	Total		F.	P.T.	P.P.	Temp.	Total		
79	23,407	—	—	—	2	2	25	—	—	—	49	49	85.445	2,093.391
80	38,782	—	—	—	3	3	31	—	—	—	92	92	77.355	2,372.235
81	86,800	—	—	—	4	4	54	—	—	—	215	215	46.083	2,476.959
82	82,321	—	—	—	2	2	102	—	—	—	204	204	24.295	2,478.104
83	15,586	—	—	—	1	1	39	—	—	—	39	39	64.160	2,502.246
84	24,321	—	—	—	1	1	61	—	—	—	61	61	41.117	2,508.121
85	44,430	—	—	—	4	4	30	—	—	—	120	120	90.029	2,700.878
87	42,180	—	—	—	3	3	52	—	—	—	155	155	71.124	3,674.727
88	43,262	—	—	—	6	6	27	—	—	—	163	163	138.690	3,767.741
89	68,608	—	—	1	6	7	38	—	—	135	228	363	102.029	5,290.928
90	66,150	—	—	1	5	6	37	—	—	940	185	1,125	90.703	17,006.803
91	280,635	1	—	—	1	2	8	6,000	—	—	8	6,008	7.127	21,408.591
92	216,356	1	—	2	14	17	31	6,000	—	120	435	6,555	78.574	30,297.288
93	195,166	1	—	—	3	4	19	6,000	—	—	56	6,056	20.495	31,029.995
94	175,924	1	—	—	1	2	33	6,000	—	—	33	6,033	11.369	34,293.218
95	118,537	1	—	—	5	6	17	6,000	—	—	84	6,084	50.617	51,325.746
96	50,099	1	—	—	1	2	17	6,000	—	—	17	6,017	39.921	120,102.198
Totals and rates:														
1958	7,609,026	6	—	5	147	158	25	36,000	—	1,295	3,686	40,981	20.765	5,385.840
1957	8,864,805	—	—	9	161	170	28	—	—	4,300	4,575	8,875	19.177	1,001.150

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identity of the operations to which this table relates is not revealed
[2] F., fatal; P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per million man-hours of exposure

GROUP III PLANTS WORKING 50,000 TO 100,000 MAN-HOURS

Woodleaf quarry, Woodleaf, Rowan County, N. C., operated by Superior Stone Company, 95,203 man-hours

Watertown quarry, Watertown, Jefferson County, N. Y., operated by General Crushed Stone Company, 81,878 man-hours

Kimballton underground mine, Kimballton, Giles County, Va., operated by Standard Lime and Cement Company, 80,680 man-hours

Rock Cut quarry, Jamesville, Onondaga County, N. Y., operated by General Crushed Stone Company, 68,657 man-hours

McLeansville quarry, McLeansville, Guilford County, N. C., operated by Superior Stone Company, 62,920 man-hours

Wallingford No. 1 quarry, Wallingford, New Haven County, Conn., operated by New Haven Trap Rock Company, 62,124 man-hours

Pleasant Gap underground mine, Pleasant Gap, Centre County, Pa. operated by Standard Lime and Cement Company, 60,586 man-hours

Cape Girardeau quarry, Cape Girardeau, Cape Girardeau County, Mo., operated by Federal Materials Company, 57,032 man-hours

GROUP IV PLANTS WORKING 30,000 TO 50,000 MAN-HOURS

Hickory quarry, Hickory, Catawba County, N. C., operated by Superior Stone Company, 47,718 man-hours

Cape Girardeau mine, Cape Girardeau, Cape Girardeau County, Mo., operated by Federal Materials Company, 46,968 man-hours

Jordanville quarry, Jordanville, Herkimer County, N. Y., operated by General Crushed Stone Company, 46,777 man-hours

Rock Hill quarry, Quakertown, Bucks County, Pa., operated by General Crushed Stone Company, 43,998 man-hours

Plainville No. 4 quarry, Plainville, Hartford County, Conn., operated by New Haven Trap Rock Company, 38,457 man-hours

TABLE II

Relative Standing of Underground Mines in the 1958 National Crushed Stone Association Safety Contest Based Upon Injury-Severity Rates [1]

Rank	Man-hours worked	Injuries [2]					Average days of disability per temp. injury	Days of disability [2]					Frequency rate [3]	Severity rate [3]
		F.	P.T.	P.P.	Temp.	Total		F.	P.T.	P.P.	Temp.	Total		
7	106,649	—	—	—	—	—	—	—	—	—	—	—	0.000	0.000
10	80,680	—	—	—	—	—	—	—	—	—	—	—	.000	.000
14	60,586	—	—	—	—	—	—	—	—	—	—	—	.000	.000
17	46,968	—	—	—	—	—	—	—	—	—	—	—	.000	.000
23	33,389	—	—	—	—	—	—	—	—	—	—	—	.000	.000
36	25,774	—	—	—	1	1	1	—	—	—	1	1	38.799	38.799
51	13,225	—	—	—	1	1	3	—	—	—	3	3	75.614	226.843
54	163,472	—	—	—	5	5	10	—	—	—	48	48	30.586	293.628
55	132,240	—	—	—	3	3	14	—	—	—	43	43	22.686	325.166
70	46,768	—	—	—	5	5	10	—	—	—	51	51	106.911	1,090.489
72	15,625	—	—	—	2	2	10	—	—	—	19	19	128.000	1,216.000
86	52,091	—	—	—	1	1	179	—	—	—	179	179	19.197	3,436.294
97	25,845	2	—	—	3	5	60	12,000	—	—	180	12,180	193.461	471,271.039
Totals and rates:														
1958	803,312	2	—	—	21	23	25	12,000	—	—	524	12,524	28.631	15,590.456
1957	1,103,835	—	—	1	13	14	43	—	—	1,500	561	2,061	12.683	1,867.127

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identity of the operations to which this table relates is not revealed
[2] F., fatal; P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per million man-hours of exposure

TABLE III

Yearly Summary—Quarries in the National Crushed Stone Association Safety Contest, 1926–58 [1]

Year	Plants	Man-hours	Injuries [2]					Days of disability [2]					Frequency rate [3]	Severity rate [3]
			Fatal	P.T.	P.P.	Temp.	Total	Fatal	P.T.	P.P.	Temp.	Total		
1926	40	5,298,983	3	—	6	207	216	18,000	—	9,000	4,239	31,239	40.763	5.895
1927	48	7,876,791	9	—	2	458	469	54,000	—	2,100	7,186	63,286	59.542	8.034
1928	53	7,509,098	8	—	4	322	334	48,000	—	8,700	5,493	62,193	44.479	8.282
1929	53	7,970,325	4	—	5	286	295	24,000	—	5,760	5,533	35,293	37.012	4.428
1930	68	8,013,415	6	—	9	227	242	36,000	—	7,250	3,671	46,921	30.199	5.855
1931	58	5,085,857	4	—	13	198	215	24,000	—	18,660	3,540	46,200	42.274	9.084
1932	40	2,661,850	1	—	4	75	80	6,000	—	6,750	2,481	15,231	30.054	5.722
1933	40	2,704,871	1	—	1	67	69	6,000	—	48	2,893	8,941	25.510	3.306
1934	46	3,288,257	1	—	2	106	109	6,000	—	2,850	1,873	10,723	33.148	3.261
1935	46	4,166,306	2	1	8	77	88	12,000	6,000	9,900	3,015	30,915	21.122	7.420
1936	50	6,399,023	5	—	14	182	201	30,000	—	8,168	4,590	42,758	31.411	6.682
1937	47	6,199,001	7	—	9	136	152	42,000	—	5,875	4,461	52,336	24.520	8.443
1938	47	4,658,119	2	—	6	76	84	12,000	—	6,600	3,184	21,784	18.033	4.677
1939	44	4,219,086	2	—	2	51	55	12,000	—	4,800	1,678	18,478	13.036	4.380
1940	46	4,358,409	1	—	5	78	84	6,000	—	2,550	3,013	11,563	19.273	2.653
1941	47	5,777,587	3	—	5	98	106	18,000	—	9,300	2,266	29,566	18.347	5.117
1942	48	7,178,935	3	2	1	183	189	18,000	12,000	1,500	4,239	35,739	26.327	4.978
1943	34	4,750,314	4	—	5	134	143	24,000	—	7,146	3,862	35,008	30.103	7.370
1944	32	3,996,433	3	—	4	118	125	18,000	—	3,000	3,323	24,323	31.278	6.086
1945	46	6,087,037	—	—	1	135	136	—	—	750	3,505	4,255	22.343	.699
1946	46	7,292,175	1	—	6	197	204	6,000	—	5,141	4,130	15,271	27.975	2.094
1947	42	6,971,790	5	—	5	197	207	30,000	—	6,900	4,990	41,890	29.691	6.008
1948	47	6,953,569	4	—	11	181	196	24,000	—	8,018	4,642	36,660	28.187	5.272
1949	57	7,166,644	3	—	11	153	167	18,000	—	9,465	3,345	30,810	23.302	4.299
1950	45	6,510,173	2	—	7	153	162	12,000	—	3,854	3,825	19,679	24.884	3.023
1951	36	5,441,304	1	—	4	100	105	6,000	—	6,325	2,381	14,706	19.297	2.703
1952	36	5,279,849	3	—	3	111	117	18,000	—	1,674	2,296	21,970	22.160	4.161
1953	47	6,555,333	—	—	9	114	123	—	—	14,892	2,882	17,774	18.763	2.711
1954	55	5,880,228	1	—	9	95	105	6,000	—	6,905	2,272	15,177	17.856	2.581
1955	60	6,507,189	1	—	3	101	105	6,000	—	750	3,241	9,991	16.136	1.535
1956	64	7,493,083	4	1	6	134	145	24,000	6,000	2,684	3,897	36,581	19.351	4.882
1957 [4]	92	8,864,805	—	—	9	161	170	—	—	4,300	4,575	8,875	19.177	1,001.150
1958	84	7,609,026	6	—	5	147	158	36,000	—	1,295	3,686	40,981	20.765	5,385.840
Total	—	196,724,865	100	4	194	5,058	5,356	600,000	24,000	192,910	120,207	937,117	27.226	4,763.592

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identity of the operations to which this table relates is not revealed
[2] F., fatal; P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure
[4] Beginning with 1957, the severity rates are based on million man-hours of exposure

TABLE IV

YEARLY SUMMARY—UNDERGROUND MINES IN NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST, 1926–58 [1]

Year	Number of plants	Man-hours worked	Injuries [2]					Days of disability [2]					Frequency rate [3]	Severity rate [3]
			Fatal	P.T.	P.P.	Temp.	Total	Fatal	P.T.	P.P.	Temp.	Total		
1926	3	517,926	—	—	—	34	34	—	—	—	533	533	65.646	1.029
1927	2	318,449	1	—	1	14	16	6,000	—	300	68	6,368	50.244	19.997
1928	5	542,193	1	—	1	68	70	6,000	—	300	888	7,188	129.105	13.257
1929	4	665,520	1	—	1	30	32	6,000	—	300	617	6,917	48.083	10.393
1930	6	595,367	1	—	1	15	17	6,000	—	225	468	6,693	28.554	11.242
1931	3	345,105	—	—	—	4	4	—	—	—	147	147	11.591	.426
1932	2	158,450	—	—	—	6	6	—	—	—	165	165	37.867	1.041
1933	3	229,381	—	—	—	11	11	—	—	—	349	349	47.955	1.521
1934	4	248,146	—	—	—	13	13	—	—	—	287	287	52.389	1.157
1935	2	175,994	—	—	—	3	3	—	—	—	249	249	17.046	1.415
1936	4	334,747	1	—	—	7	8	6,000	—	—	117	6,117	23.899	18.274
1937	3	364,680	—	—	—	3	3	—	—	—	91	91	8.226	.250
1938	3	334,442	—	—	—	2	2	—	—	—	133	133	5.980	.398
1939	4	393,039	—	—	1	7	8	—	—	600	457	1,057	20.354	2.689
1940	4	375,987	—	—	1	8	9	—	—	4,500	888	5,388	23.937	14.330
1941	4	591,568	—	—	1	15	16	—	—	750	169	919	27.047	1.553
1942	4	785,894	—	—	1	33	34	—	—	1,800	1,213	3,013	43.263	3.834
1943	5	1,019,771	—	—	3	45	48	—	—	4,950	1,123	6,073	47.069	5.955
1944	4	727,496	1	—	1	27	29	6,000	—	2,400	796	9,196	39.863	12.641
1945	7	1,238,845	—	—	2	22	24	—	—	3,000	755	3,755	19.373	3.031
1946	8	1,338,563	2	—	2	31	35	12,000	—	675	1,045	13,720	26.147	10.250
1947	8	1,291,162	5	—	1	29	35	30,000	—	75	1,588	31,663	27.107	24.523
1948	4	940,031	—	—	—	16	16	—	—	—	935	935	17.021	.995
1949	5	981,692	—	—	1	17	18	—	—	900	467	1,367	18.336	1.392
1950	6	1,102,273	1	—	1	25	27	6,000	—	3,000	810	9,810	24.495	8.900
1951	6	1,179,458	—	—	1	21	22	—	—	1,125	818	1,943	18.653	1.647
1952	6	1,137,449	—	—	—	19	19	—	—	—	583	583	16.704	.513
1953	6	1,260,523	—	—	—	12	12	—	—	—	487	487	9.520	.386
1954	12	915,362	1	—	—	9	10	6,000	—	—	754	6,754	10.925	7.379
1955	13	1,315,811	—	1	—	7	8	—	6,000	—	297	6,297	6.080	4.786
1956	12	1,066,873	—	—	1	15	16	—	—	300	430	730	14.997	.684
1957 [4]	13	1,103,835	—	—	1	13	14	—	—	1,500	561	2,061	12.683	1,867.127
1958	13	803,312	2	—	—	21	23	12,000	—	—	524	12,524	28.631	15,590.456
Total	—	24,399,344	17	1	22	602	642	102,000	6,000	26,700	18,812	153,512	26.312	6,291.645

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identity of the operations to which this table relates is not revealed
[2] F., fatal; P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure
[4] Beginning with 1957, the severity rates are based on million man-hours of exposure

Hales Corner quarry, Hales Corner, Milwaukee County, Wis., operated by Consumers Company, 38,422 man-hours

Ashland quarry, Ashland, Worcester County, Mass., operated by B and M Crushed Stone Corporation, 34,918 man-hours

Tyrone underground mine, Lawrenceburg, Anderson County, Ky., operated by Kentucky Stone Company, Incorporated, 33,389 man-hours

Big Horn quarry, Warren, Carbon County, Mont., operated by Weaver Construction Company, 32,652 man-hours

Rapid City quarry, Rapid City, Pennington County, S. D., operated by Pete Lien and Sons, 30,932 man-hours

GROUP V PLANTS WORKING 30,000 MAN-HOURS OR LESS

White Haven quarry, White Haven, Luzerne County, Pa., operated by General Crushed Stone Company, 28,222 man-hours

Buckland quarry, Buckland, Auglaize County, Ohio, operated by National Lime and Stone Company, 26,400 man-hours

Cairo quarry, Cairo, Greene County, N. Y., operated by Catskill Mountain Stone Corporation, 23,000 man-hours

Knoxville quarry, Knoxville, Knox County, Tenn., operated by Standard Lime and Cement Company, 22,672 man-hours

Newport quarry, Newport, Perry County, Pa., operated by Bradford Hills Quarry, Incorporated, 19,762 man-hours

TABLE V

YEARLY SUMMARY—QUARRIES AND UNDERGROUND MINES IN NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST, 1926–58 [1]

Year	Plants	Man-hours worked	Injuries [2]					Days of disability [2]					Frequency rate [3]	Severity rate [3]
			Fatal	P.T.	P.P.	Temp.	Total	Fatal	P.T.	P.P.	Temp.	Total		
1926	43	5,816,909	3	—	6	241	250	18,000	—	9,000	4,772	31,772	42.978	5.462
1927	50	8,195,240	10	—	3	472	485	60,000	—	2,400	7,254	69,654	59.181	8.499
1928	58	8,051,291	9	—	5	390	404	54,000	—	9,000	6,381	69,381	50.178	8.617
1929	57	8,635,845	5	—	6	316	327	30,000	—	6,060	6,150	42,210	37.865	4.888
1930	74	8,608,782	7	—	10	242	259	42,000	—	7,475	4,139	53,614	30.086	6.228
1931	61	5,430,962	4	—	13	202	219	24,000	—	18,660	3,687	46,347	40.324	8.534
1932	42	2,820,300	1	—	4	81	86	6,000	—	6,750	2,646	15,396	30.493	5.459
1933	43	2,934,252	1	—	1	78	80	6,000	—	48	3,242	9,290	27.264	3.166
1934	50	3,536,403	1	—	2	119	122	6,000	—	2,850	2,160	11,010	34.498	3.113
1935	48	4,342,300	2	1	8	80	91	12,000	6,000	9,900	3,264	31,164	20.957	7.177
1936	54	6,733,770	6	—	14	189	209	36,000	—	8,168	4,707	48,875	31.038	7.258
1937	50	6,563,681	7	—	9	139	155	42,000	—	5,875	4,552	52,427	23.615	7.987
1938	50	4,992,561	2	—	6	78	86	12,000	—	6,600	3,317	21,917	17.226	4.390
1939	48	4,612,125	2	—	3	58	63	12,000	—	5,400	2,135	19,535	13.660	4.236
1940	50	4,734,396	1	—	6	86	93	6,000	—	7,050	3,901	16,951	19.643	3.580
1941	51	6,369,155	3	—	6	113	122	18,000	—	10,050	2,435	30,485	19.155	4.786
1942	52	7,964,829	3	2	2	216	223	18,000	12,000	3,300	5,452	38,752	27.998	4.865
1943	39	5,770,085	4	—	8	179	191	24,000	—	12,096	4,985	41,081	33.102	7.120
1944	36	4,723,929	4	—	5	145	154	24,000	—	5,400	4,119	33,519	32.600	7.096
1945	53	7,325,882	—	—	3	157	160	—	—	3,750	4,260	8,010	21.840	1.093
1946	54	8,630,738	3	—	8	228	239	18,000	—	5,816	5,175	28,991	27.692	3.359
1947	50	8,262,952	10	—	6	226	242	60,000	—	6,975	6,578	73,553	29.287	8.902
1948	51	7,893,600	4	—	11	197	212	24,000	—	8,018	5,577	37,595	26.857	4.763
1949	62	8,148,336	3	—	12	170	185	18,000	—	10,365	3,812	32,177	22.704	3.949
1950	51	7,612,446	3	—	8	178	189	18,000	—	6,854	4,635	29,489	24.828	3.874
1951	42	6,620,762	1	—	5	121	127	6,000	—	7,450	3,199	16,649	19.182	2.515
1952	42	6,417,298	3	—	3	130	136	18,000	—	1,674	2,879	22,553	21.193	3.514
1953	53	7,815,856	—	—	9	126	135	—	—	14,892	3,369	18,261	17.273	2.336
1954	67	6,795,590	2	—	9	104	115	12,000	—	6,905	3,026	21,931	16.923	3.227
1955	73	7,823,000	1	1	3	108	113	6,000	6,000	750	3,538	16,288	14.445	2.082
1956	76	8,559,956	4	1	7	149	161	24,000	6,000	2,984	4,327	37,311	18.809	4.359
1957 [4]	105	9,968,640	—	—	10	174	184	—	—	5,800	5,136	10,936	18.458	1,097.040
1958	97	8,412,338	8	—	5	168	181	48,000	—	1,295	4,210	53,505	21.516	6,360.301
Total	—	221,124,209	117	5	216	5,660	5,998	702,000	30,000	219,610	139,019	1,090,629	27.125	4,932.201

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identity of the operations to which this table relates is not revealed
[2] P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per thousand man-hours of exposure
[4] Beginning with 1957, the severity rates are based on million man-hours of exposure

TABLE VI

INJURIES, BY CLASSIFICATION, AT QUARRIES AND UNDERGROUND MINES IN 1958 NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST

Classification	Fatal	Permanent		Temporary	Total
		Total	Partial		
Falls and slides of rock	2	—	—	5	7
Handling materials	—	—	1	25	26
Hand tools	—	—	—	8	8
Explosives	—	—	—	1	1
Haulage	3	—	—	18	21
Falls of persons	—	—	—	30	30
Bumping against objects	—	—	—	12	12
Falling objects	1	—	—	16	17
Flying objects	—	—	—	9	9
Electricity	—	—	—	6	6
Drilling	—	—	1	4	5
Machinery	1	—	3	18	22
Stepping on objects	—	—	—	9	9
Burns	—	—	—	5	5
Other causes	1	—	—	2	3
Total	8	—	5	168	181

TABLE VII

DAYS OF DISABILITY, BY CLASSIFICATION OF INJURIES, AT QUARRIES AND UNDERGROUND MINES IN 1958 NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST

Classification	Fatal	Permanent		Temporary	Total
		Total	Partial		
Falls and slides of rock	12,000	—	—	334	12,334
Handling materials	—	—	60	485	545
Hand tools	—	—	—	399	399
Explosives	—	—	—	25	25
Haulage	18,000	—	—	499	18,499
Falls of persons	—	—	—	710	710
Bumping against objects	—	—	—	321	321
Falling objects	6,000	—	—	198	6,198
Flying objects	—	—	—	101	101
Electricity	—	—	—	136	136
Drilling	—	—	100	177	277
Machinery	6,000	—	1,135	620	7,755
Stepping on objects	—	—	—	111	111
Burns	—	—	—	77	77
Other causes	6,000	—	—	17	6,017
Total	48,000	—	1,295	4,210	53,505

Rimer quarry, Rimer, Putnam County, Ohio, operated by National Lime and Stone Company 16,800 man-hours

Plant No. 4 quarry, Knippa, Uvalde County, Texas, operated by Southwest Stone Company, 12,195 man-hours

Randville quarry, Randville, Dickerson County, Mich., operated by Superior Rock Products Company, 11,640 man-hours

The plant with the highest number of man-hours without disabling work injury in each group is considered the Group Winner and will receive from the Association a wooden plaque with a bar inscribed Group Winner and indicating the number of man-hours worked and the year in which the record was made. Each employee will receive an individually inscribed safety award certificate from the Association. The five Group Winners are as follows:

GROUP I—Clinton Point quarry, New York Trap Rock Corporation

GROUP II—North Branford No. 7 quarry, New Haven Trap Rock Company

GROUP III—Woodleaf quarry, Superior Stone Company

GROUP IV—Hickory quarry, Superior Stone Company

GROUP V—White Haven quarry, General Crushed Stone Company

The Explosives Engineer Award provided by the Explosives Engineer magazine will be presented in recognition of the greatest number of consecutive days of operation without a disabling work injury. The winner of this award will be announced at the National Crushed Stone Association Annual Convention at Chicago, Illinois, in 1960.

Statistics of the Contest

The overall injury experience at the 97 crushed stone operations participating in the 1958 Contest was not favorable. The injury-severity rate of 6,360.301 days lost per million man-hours of exposure to hazard was the highest for any crushed stone contest since 1947. The high severity rates in 1947 and 1958 resulted from the large number of fatalities reported in those years. In 1947, 10 injuries resulted in death and in 1958, 8. In 1958 there were 5 permanent partial and 168 temporary total injuries at enrolled plants. These injuries had a total time loss or charge of 53,505 days.

The frequency rate for all competing plants in 1958 was 21.516 per million man-hours. This rate was also less favorable than that of 18.458 for 1957 but more favorable than the overall frequency rate of 27.125 for the 33 years of the contest. The 1958 injury-frequency rate showed a decrease of 21 per cent from the corresponding 33 year average rate for all enrolled operations.

Of the 97 enrolled plants in the 1958 Contest, 84 were quarries and 13 were underground mines. The 84 quarries experienced a total of 158 injuries of which 6 were fatal, 5 permanent partial, and 147 temporary total. (See Table III.) The injury-severity rate of 5,385.840 for these injuries was 438 per cent higher than the corresponding rate of 1,001.150 for 1957, and 13 per cent higher than the overall rate of 4,763.592 for the 33 years of the contest.

In the underground mines enrolled in the 1958 Contest there were 2 fatal and 21 temporary total injuries. (See Table IV.) The injury-severity rate increased from 1,867.127 in 1957 to 15,590.456 and rose over the overall rate of 6,291.645 for the 33 year average.

Injury Free Operations

There were 33 operations, 28 quarries and 5 underground mines that achieved perfect safety records during the 1958 competitive year. These injury free operations are awarded the National Crushed Stone Association Safety Award and each employee of each operation receives an individual certificate inscribed with his name, the plant and company name, and the year in which the record was established. These 33 plants were worked 2,415,566 man-hours representing 29 per cent of the total worktime of all plants enrolled in the contest.

Twenty-three states were represented in the 1958 Contest. They were: New York with 18 operations; Pennsylvania, 10; Kentucky and Ohio, 9 each; North Carolina 8; Missouri, 6; Virginia, 5; Illinois and Wisconsin, 4 each; Connecticut and Iowa, 3 each; Georgia, Maryland, Massachusetts, Michigan, Tennessee, and Texas, 2 each; and single operations in Alabama, Indiana, Montana, New Jersey, Oklahoma, and South Dakota.

TABLE VIII

NUMBER AND PERCENTAGE DISTRIBUTION OF INJURIES, BY CLASSIFICATION, AT PLANTS ENROLLED IN NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST, 1956–58

Classification	1956		1957		1958		Total	
	Number	Per cent of total	Number	Per cent of total	Number	Per cent of total	Number	Per cent of total
Falls and slides of rock	6	3.7	14	7.6	7	3.9	27	5.1
Handling materials	22	13.7	27	14.7	26	14.4	75	14.3
Hand tools	6	3.7	6	3.3	8	4.4	20	3.8
Explosives	4	2.5	1	.6	1	.5	6	1.2
Haulage	15	9.3	27	14.7	21	11.6	63	12.0
Falls of persons	28	17.4	33	17.9	30	16.6	91	17.3
Bumping against objects	7	4.3	7	3.8	12	6.6	26	4.9
Falling objects	23	14.3	13	7.0	17	9.4	53	10.1
Flying objects	9	5.6	13	7.0	9	5.0	31	5.9
Electricity	3	1.9	—	—	6	3.3	9	1.7
Drilling	—	—	10	5.4	5	2.8	15	2.9
Machinery	18	11.2	18	9.8	22	12.1	58	11.0
Stepping on objects	4	2.5	3	1.6	9	5.0	16	3.0
Burns	5	3.1	6	3.3	5	2.8	16	3.0
Other causes	11	6.8	6	3.3	3	1.6	20	3.8
Total	161	100.0	184	100.0	181	100.0	526	100.0

Injury Experience

Principal causes of injury among the 1958 competing participants were: Falls of persons resulting in 30 injuries or 16.6 per cent of all injuries; handling materials, resulting in 14.4 per cent; machinery, 12.1 per cent; and haulage, 11.6 per cent. The most severe injuries during the 1958 Contest resulted from haulage, falls and slides of rock, machinery, falling objects, and other causes. These five causes of injuries were responsible for 95 per cent of the total number of days of disability.

The Contest

A plant may be enrolled on application to the Branch of Accident Analysis, Division of Safety, Bureau of Mines, Washington 25, D. C.

TABLE IX

NUMBER AND PERCENTAGE DISTRIBUTION OF DAYS OF DISABILITY FROM INJURIES, BY CLASSIFICATION, AT PLANTS ENROLLED IN NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST, 1956–58

Classification	1956		1957		1958		Total	
	Days of disability	Per cent of total	Days of disability	Per cent of total	Days of disability	Per cent of total	Days of disability	Per cent of total
Falls and slides of rock	6,235	16.7	3,156	28.9	12,334	23.1	21,725	21.4
Handling materials	6,606	17.7	834	7.6	545	1.0	7,985	7.9
Hand tools	141	.4	45	.4	399	.7	585	.6
Explosives	12,630	33.8	3	(1)	25	.1	12,658	12.4
Haulage	6,866	18.4	2,780	25.4	18,499	34.6	28,145	27.7
Falls of persons	1,169	3.1	1,461	13.4	710	1.3	3,340	3.3
Bumping against objects	309	.8	63	.6	321	.6	693	.7
Falling objects	1,139	3.1	406	3.7	6,198	11.6	7,743	7.6
Flying objects	64	.2	267	2.4	101	.2	432	.4
Electricity	12	(1)	—	—	136	.3	148	.1
Drilling	—	—	468	4.3	277	.5	745	.7
Machinery	1,899	5.1	979	8.9	7,755	14.5	10,633	10.4
Stepping on objects	27	.1	12	.1	111	.2	150	.2
Burns	98	.3	160	1.5	77	.1	335	.3
Other causes	116	.3	302	2.8	6,017	11.2	6,435	6.3
Total	37,311	100.0	10,936	100.0	53,505	100.0	101,752	100.0

[1] Less than 0.05 per cent

TABLE X

EMPLOYMENT AND INJURY DATA FOR CRUSHED STONE PLANTS ENROLLED IN NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST, 1957 AND 1958, COVERING IDENTICAL PLANTS FOR BOTH YEARS AND PLANTS ENROLLED ONLY IN 1957 OR IN 1958 [1]

	No.	Man-hours worked	Injuries [2]					Days of disability [2]					Frequency rate [3]	Severity rate [3]
			F.	P.T.	P.P.	Temp.	Total	F.	P.T.	P.P.	Temp.	Total		
Plants enrolled in 1957 only	19	1,111,964	—	—	—	25	25	—	—	—	926	926	22.483	832.761
Identical plants enrolled both years, 1957	86	8,856,676	—	—	10	149	159	—	—	5,800	4,210	10,010	17.953	1,130.221
Identical plants enrolled both years, 1958	86	7,281,935	7	—	3	143	153	42,000	—	1,175	3,669	46,844	21.011	6,432.906
Plants enrolled in 1958 only	11	1,130,403	1	—	2	25	28	6,000	—	120	541	6,661	24.770	5,892,589

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identity of the operations to which this table relates is not revealed
[2] F., fatal; P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability
[3] Frequency rate indicates the number of fatal, permanent, and othe disabling injuries per million man-hours of exposure; severity rate indicates the number of days of disability lost from injuries per million man-hours of exposure

TABLE XI

AVERAGE DAYS OF DISABILITY PER TEMPORARY INJURY AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY CONTEST

Year	Underground mines			Open quarries			Total		
	Temporary injuries	Days of disability	Average days disability	Temporary injuries	Days of disability	Average days disability	Temporary injuries	Days of disability	Average days disability
1926	34	533	16	207	4,239	20	241	4,772	20
1927	14	68	5	458	7,186	16	472	7,254	15
1928	68	888	13	322	5,493	17	390	6,381	16
1929	30	617	21	286	5,533	19	316	6,150	19
1930	15	468	31	227	3,671	16	242	4,139	17
1931	4	147	37	198	3,540	18	202	3,687	18
1932	6	165	28	75	2,481	33	81	2,646	33
1933	11	349	32	67	2,893	43	78	3,242	42
1934	13	287	22	106	1,873	18	119	2,160	18
1935	3	249	83	77	3,015	39	80	3,264	41
1936	7	117	17	182	4,590	25	189	4,707	25
1937	3	91	30	136	4,461	33	139	4,552	33
1938	2	133	67	76	3,184	42	78	3,317	43
1939	7	457	65	51	1,678	33	58	2,135	37
1940	8	888	111	78	3,013	39	86	3,901	45
1941	15	169	11	98	2,266	23	113	2,435	22
1942	33	1,213	37	183	4,239	23	216	5,452	25
1943	45	1,123	25	134	3,862	29	179	4,985	28
1944	27	796	29	118	3,323	28	145	4,119	28
1945	22	755	34	135	3,505	26	157	4,260	27
1946	31	1,045	34	197	4,130	21	228	5,175	23
1947	29	1,588	55	197	4,990	25	226	6,578	29
1948	16	935	58	181	4,642	26	197	5,577	28
1949	17	467	27	153	3,345	22	170	3,812	22
1950	25	810	32	153	3,825	25	178	4,635	26
1951	21	818	39	100	2,381	24	121	3,199	26
1952	19	583	31	111	2,296	21	130	2,879	22
1953	12	487	41	114	2,882	25	126	3,369	27
1954	9	754	84	95	2,272	24	104	3,026	29
1955	7	297	42	101	3,241	32	108	3,538	33
1956	15	430	29	134	3,897	29	149	4,327	29
1957	13	561	43	161	4,575	28	174	5,136	30
1958	21	524	25	147	3,686	25	168	4,210	25
Total	602	18,812	31	5,058	120,207	24	5,660	139,019	25

Digest of Federal-Aid Highway Act of 1959 – Public Law 86

Prepared by Research Department
National Highway Users Conference
Washington, D. C.

THE new Federal-Aid Highway Act of 1959 provides, under Title II—Internal Revenue Code and Highway Trust Fund Amendments, additional financing for the Highway Trust Fund for the period from October 1, 1959 to July 1, 1964, estimated to yield an additional $3,472 million.

Temporary Gasoline Tax Increase—The federal tax on gasoline, diesel fuel, and special motor fuels is increased by one cent per gallon. The increase, from three to four cents per gallon, will be effective for 21 months, from October 1, 1959 until July 1, 1961. The expected yield to the Highway Trust Fund over this period is $333 million in fiscal year 1960, $577 million in fiscal year 1961, and $75 million in fiscal year 1962, for a total of $985 million.

Excise Tax on Automobiles and Parts and Accessories—Beginning July 1, 1961 until July 1, 1964, the law allocates to the Highway Trust Fund 5 percentage points of the 10 per cent federal excise tax on automobiles and 5 percentage points of the 8 per cent tax on automotive parts and accessories. This earmarking is estimated to produce $802 million in fiscal year 1962, $831 million in fiscal year 1963, and $854 million in fiscal year 1964, for a total of $2,487 million.

Wholesale Distributor Treated as Producer—The law redefines the term "producer" to include a refiner, compounder, blender, or wholesale distributor, as well as a producer.

Presently, the federal gasoline tax is payable by the producer or importer at the time he makes his sale. Thus, in the case of an integrated company no tax is collected until after the time of the sale to the service station or to the ultimate consumer. Where sales are made to independent wholesalers, however, the tax is presently collected at the time of that sale. The new law will permit, effective January 1, 1960, the wholesale distributor, and a dealer selling gasoline exclusively to producers, to purchase gasoline tax free and then pay the tax at the time of his sale.

Gasoline Tax Refunds—The refund procedure provided for in the Highway Revenue Act of 1956 is made applicable to the one cent increase when such fuel is used for non-highway purposes, or by local transit system vehicles and intercity buses under certain circumstances.

Federal-Aid Highway Program

Interstate System Authorization Reduced—The law reduces the 1961 fiscal year authorization for the Interstate System from $2,500 million to $2,000 million. This was previously increased by the Federal-Aid Highway Act of 1958 from $2,200 million to $2,500 million.

Interstate System Cost Estimate Approved for Use in Apportioning Funds for Fiscal 1962—The 1958 estimate of cost of completing the Interstate System was approved as the basis for apportioning funds to the states for the fiscal year 1962. This estimate had previously been approved for the 1960 and 1961 fiscal years.

Additional Funds for Parkways—An additional $2 million was authorized to be appropriated for parkways for the 1960 fiscal year. Parkway funds are payable from the Treasury general fund.

Interstate System Study in Alaska and Hawaii—The Secretary of Commerce is directed to make a study of the need for extension of the Interstate System in Alaska and Hawaii. A report to Congress is required by January 14, 1960, which shall include recommendations as to the approximate routes and mileage thereof.

Exemption from Billboard Standards—The federal standards for state regulation of billboards along the Interstate System were amended to exempt from the standards "those segments of the Interstate System which traverse commercial or industrial zones within the presently existing boundaries of incorporated municipalities wherein the use of real property adjacent to the Interstate System is subject to municipal regulation or control, or which traverse other areas where the land use, as of the date of approval of this Act, is clearly established by state law as industrial or commercial."

(*Continued on Page 23*)

Crushed and Broken Stone Production Reaches Record High in 1958

By WALLACE W. KEY
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Under the Supervision of G. W. Josephson
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CRUSHED and broken stone production in 1958 exceeded the record established in 1957 by nearly 2 million tons despite reduced activity in several fields of use. Total output in 1958 as reported to the Bureau of Mines, United States Department of the Interior, reached a new high of 533 million short tons valued at $746 million. The increased demand for concrete and roadstone under the Federal Highway Program offset reduced sales for industrial applications.

As in previous years, production included crushed stone used for concrete aggregate, roadstone, cement, lime, metallurgical flux, railroad ballast, refractory stone, agricultural limestone, abrasives, and riprap, and in various chemical and other manufacturing processes. Asphaltic stone is excluded from the total, but a small quantity of crushed and broken slate is included for the first time. Both 1957 and 1958 United States totals include Alaska and Hawaii, but areas administered by the United States are shown separately.

Over half the crushed and broken stone went into concrete and roadstone applications in 1958. Nearly 90 per cent of the aggregates produced for these purposes came from commercial operations. The accelerated Federal Highway Program and a number of dam and airfield construction projects supported crushed stone sales in 1958. Consequently output of stone for concrete and roadstone rose to 322 million tons—an increase of over 24 million tons compared with 1957.

(*Continued on Page 22*)

CRUSHED AND BROKEN STONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USES

Use	1957		1958	
	Short tons (thousands)	Value (thousands)	Short tons (thousands)	Value (thousands)
Agriculture	19,727	$32,290	20,545	$34,551
Cement	78,697	83,062	80,757	85,748
Concrete and roadstone	[1] 298,049	[1] 405,659	322,109	427,190
Fill	8,354	7,659	14,415	13,762
Filtration	172	442	178	404
Flux	39,890	57,390	26,045	37,491
Glass	1,425	4,118	1,178	3,443
Lime	[1] 17,862	[1] 26,571	15,708	24,043
Mineral food	460	2,758	635	3,664
Poultry grit	592	3,301	767	7,117
Railroad ballast	16,582	18,020	10,567	11,809
Refractory	1,720	11,894	920	7,810
Riprap	[1] 15,132	[1] 19,007	15,374	18,887
Roofing granules, aggregates, and chips	1,635	9,509	1,775	10,583
Stone sand	3,296	3,643	2,619	3,215
Terrazzo	385	4,650	370	4,588
Other uses [2] and unspecified	[1] 26,989	[1] 51,741	18,856	51,650
Total	[1] 530,967	[1] 741,714	532,818	745,955

[1] Revised figure
[2] Includes some uses listed separately in the limestone table

STONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATES [1]

State	1957		1958	
	Short tons (thousands)	Value (thousands)	Short tons (thousands)	Value (thousands)
Alabama	[2] 9,519	[2] $11,972	[2] 11,080	[2] $17,068
Alaska	528	1,953	615	2,065
Arizona	2,101	2,982	1,528	2,731
Arkansas	[2] 7,278	[2] 8,378	8,461	10,178
California	[2] 41,351	[2] 53,591	32,423	48,345
Colorado	2,438	4,168	2,930	4,943
Connecticut	6,199	10,040	4,223	6,863
Delaware	[3]	[3]	[3]	[3]
Florida	21,786	30,467	[2] 23,549	[2] 30,983
Georgia	[2] 9,065	[2] 15,833	12,129	31,108
Hawaii	2,585	4,632	2,377	4,446
Idaho	1,542	2,759	1,122	1,710
Illinois	31,861	41,835	35,016	44,245
Indiana	14,460	33,094	15,394	31,974
Iowa	15,214	18,768	21,045	26,138
Kansas	[2] 10,412	[2] 11,926	[2] 12,424	[2] 15,036
Kentucky	12,718	16,714	12,597	17,360
Louisiana	4,383	7,152	5,453	9,532
Maine	[2] 889	[2] 3,076	880	2,760
Maryland	6,140	13,392	6,721	14,387
Massachusetts	4,877	13,165	4,649	12,354
Michigan	34,495	34,176	27,188	26,846
Minnesota	[2] 2,968	[2] 8,175	3,519	9,560
Mississippi	[2] 60	[2] 54	[2] 102	[2] 92
Missouri	22,098	29,836	24,276	32,878
Montana	2,567	3,654	1,545	2,214
Nebraska	3,065	3,749	3,555	4,747
Nevada	925	1,585	813	1,335
New Hampshire	[3]	[3]	[3]	[3]
New Jersey	8,792	21,222	8,229	19,193
New Mexico	1,348	1,618	1,730	1,507
New York	24,324	44,237	22,598	38,219
North Carolina	[2] 9,455	[2] 12,839	12,385	19,132
North Dakota	29	52	23	35
Ohio	[2] 37,451	[2] 61,847	29,122	49,782
Oklahoma	12,016	14,064	10,794	12,232
Oregon	[4] 10,583	[4] 11,745	15,004	15,483
Pennsylvania	43,397	77,095	40,049	69,694
Rhode Island	[2] 4	[2] 14	[2] 3	[2] 8
South Carolina	[2] 3,413	[2] 4,581	[2] 3,637	[2] 5,229
South Dakota	1,718	5,068	1,395	4,095
Tennessee	[2] 15,354	[2] 24,155	[2] 16,850	[2] 26,814
Texas	[4] 31,249	[4] 36,154	36,076	40,912
Utah	7,854	8,540	13,126	13,949
Vermont	[2] 557	[2] 11,404	808	15,789
Virginia	[2] 14,244	[2] 21,158	15,413	27,504
Washington	[4] 8,897	[4] 11,645	7,837	9,991
West Virginia	6,989	11,934	[2] 5,599	[2] 9,990
Wisconsin	12,434	22,455	13,722	23,334
Wyoming	1,291	2,266	1,099	1,472
Undistributed	10,500	34,183	4,227	9,947
Total [5]	[4] 533,423	[4] 825,402	535,340	826,209
American Samoa	34	37	30	59
Canton Island				
Guam	1,034	1,132	684	751
Midway Island	3,875	6,700	175	476
Panama Canal Zone	59	99	140	237
Puerto Rico	2,452	3,505	1,986	2,768
Virgin Islands	11	31	25	81
Wake Island	5	6	10	37

[1] Includes slate
[2] To avoid disclosure of individual company confidential data, certain state totals are incomplete, the portion not included being combined with "Undistributed" The class of stone omitted from such state totals is noted in the state tables in the Statistical Summary chapter of the Minerals Yearbook
[3] Figures withheld to avoid disclosing individual company confidential data; included with "Undistributed"
[4] Revised figure
[5] Includes: 1957—2,456,000 short tons of dimension stone valued at $83,688,000; 1958—2,522,000 short tons, $80,254,000

CRUSHED AND BROKEN STONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY KINDS

Kind	1957		1958	
	Short tons (thousands)	Value (thousands)	Short tons (thousands)	Value (thousands)
Granite	41,097	$49,543	31,292	$45,415
Basalt	[1] 43,737	[1] 72,389	43,945	68,466
Marble	1,274	9,635	1,269	12,025
Limestone	382,069	511,882	390,468	516,765
Shell	[1] 19,098	[1] 27,563	18,916	31,876
Calcareous marl	1,916	1,804	1,803	1,660
Sandstone	15,739	37,238	24,484	42,364
Slate	512	4,409	523	5,028
Miscellaneous stone	25,525	27,251	20,118	22,356
Total	[1] 530,967	[1] 741,714	532,818	745,955

[1] Revised figure

LIMESTONE AND DOLOMITE (CRUSHED AND BROKEN STONE) SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USES

Use	1957		1958	
	Short tons (thousands)	Value (thousands)	Short tons (thousands)	Value (thousands)
Concrete and roadstone	201,631	$264,727	226,693	$288,956
Flux	39,384	56,113	25,616	36,537
Agriculture	18,929	31,362	19,922	33,901
Railroad ballast	8,365	9,966	4,307	5,290
Riprap	5,357	5,886	4,763	5,131
Alkali manufacture	4,899	4,551	5,420	7,811
Calcium carbide manufacture	857	839	742	727
Cement—portland and natural	72,103	75,677	73,976	78,240
Coal-mine dusting	565	2,231	479	1,921
Fill	17	67	1,500	1,500
Filler (not whiting substitute):				
Asphalt	2,054	5,343	2,333	5,672
Fertilizer	345	718	424	895
Other	541	2,162	384	590
Filtration	120	234	125	217
Glass manufacture	1,204	3,589	964	2,864
Lime and dead-burned dolomite	17,146	25,764	14,508	22,093
Limestone sand	2,311	3,054	1,431	2,272
Limestone whiting [1]	809	6,019	712	6,379
Magnesia [2]	143	406	136	376
Mineral food	453	2,657	623	3,551
Mineral (rock) wool	7	8	3	6
Paper manufacture	504	1,356	417	1,210
Poultry grit	129	825	180	906
Refractory (dolomite)	524	1,127	369	558
Road base	130	130	.....	.....
Sugar refining	780	1,866	850	2,004
Other uses [3]	1,747	3,717	1,989	5,405
Use unspecified	1,015	1,488	1,602	1,753
Total	382,069	511,882	390,468	516,765

[1] Includes stone for filler for calcimine, caulking compounds, ceramics, chewing gum, explosives, floor coverings, foundry compounds, glue, grease, insecticides, leather goods, paint, paper, phonograph records, picture frame moldings, plastics, pottery, putty, roofing, rubber, toothpaste, wire coating, and unspecified uses. Excludes limestone whiting made by companies from purchased stone

[2] Includes stone for refractory magnesia

[3] Includes stone for acid neutralization, carbon dioxide, chemicals (unspecified), concrete products, disinfectant and animal sanitation, dyes, electrical products, oil well drilling, patching plaster, rayons, rice milling, roofing granules, stucco, terrazzo, artificial stone, and water treatment

CRUSHED STONE SOLD OR USED IN THE UNITED STATES IN 1958, BY METHOD OF TRANSPORTATION

Method of transportation	Commercial operations		Commercial and noncommercial [1] operations	
	Short tons (thousands)	Per cent of total	Short tons (thousands)	Per cent of total
Truck	295,360	61	344,858	65
Rail	81,716	17	81,716	15
Waterway	56,984	12	56,984	11
Unspecified	49,260	10	49,260	9
Total	483,320	100	532,818	100

[1] Entire output of noncommercial operations assumed to be moved by truck

Crushed and Broken Stone Production Reaches Record High in 1958

(*Continued from Page 19*)

Portland and natural cement production consumed 15 per cent of the year's crushed and broken stone—an increase of 3 per cent in tonnage compared with 1957—and agriculture took 4 per cent of the total—an increase of 4 per cent in tonnage. Quantities for riprap and fill also increased, but for other major uses declined.

Limestone and dolomite accounted for 73 per cent of the total crushed stone in 1958, and was quarried in 46 states. Furnace flux amounted to 7 per cent of the total limestone produced in 1958. However, reduced steel output resulted in a decrease of 35 per cent limestone consumption for this purpose compared with 1957.

The tables present the salient statistics of the crushed and broken stone industry for 1957 and 1958.

Fred A. Pampel
1897-1959

THE National Crushed Stone Association Manufacturers Division is shocked and saddened by the sudden death of Fred A. Pampel, Assistant Sales Manager of the Conveyor Equipment Section of the Chain Belt Co., Milwaukee, Wisconsin.

Mr. Pampel had served on the Board of Directors of the Manufacturers Division from 1955 to 1958 and was elected to the Division's Executive Committee in 1959. He faithfully served his office with vigor and integrity. He will be missed greatly by his large number of friends throughout the entire crushed stone industry and by those who worked with him and knew him so well.

Death came suddenly as a result of a heart attack on Tuesday, August 18, 1959, in Milwaukee, Wisconsin. He is survived by his wife, Lillian, and two sons, Leonard F. and Fred C. Pampel.

Harold Williams
1877-1959

THE National Crushed Stone Association regretfully records the passing of Harold Williams, Honorary Member of the Board of Directors, who passed away June 17, 1959, at Brookline, Massachusetts.

A practicing attorney until his retirement several years ago, Mr. Williams will be remembered best for his success in the establishment of an effective defense for quarry operators against alleged blasting claims. He was, for many years, a helpful and scholarly contributor to NCSA Convention programs. His counsel during the days of the Code Authority was of great benefit to NCSA member producers.

Mr. Williams' death has marked the end of distinguished service to his profession, to his state, and to the National Crushed Stone Association for over a quarter of a century. He will be missed greatly by NCSA members who knew him and who worked with him over the years.

Aggregates for Runway Pavements

(*Continued from Page 8*)

Samples of mix made with this same granite were obtained from a blacktop plant and the 1/4 to 3/8 in. material screened out and tested. It did not strip. Further study in the Laboratory indicated that the technique described in the test method was inadequate for penetration grade asphalt. This leads us to believe that the static immersion test may have merit in estimating the behavior of asphalt and aggregate in cutback mixes, but its use is questionable when applied to mixtures in which penetration grade asphalt is being used. In general, stripping is not a serious problem in hot-mix, hot-laid, well designed asphalt surfacing mixtures.

Aggregates that are hard and sound when crushed and properly graded can be made into bituminous concrete of high stability and durability. With due attention to skid resistance, its performance should be entirely satisfactory.

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Digest of Federal-Aid Highway Act

(*Continued from Page 18*)

Emergency Relief Amended—The emergency relief provision was amended to provide that 100 per cent federal funds may be used for repair or reconstruction of forest highways, forest development roads and trails, park roads and trails, and Indian Reservation roads damaged by a catastrophe, regardless of whether or not they are on any federal-aid highway system.

Bridges on Federal Dams—The authorization for building bridges on federal dams was increased from $10 million to $13 million.

W. T. Ragland, Sr.

1895-1959

W. TRENT RAGLAND, SR., builder, executive, friend, has joined that silent host of individuals whose achievements are their enduring monuments. His death on August 9, 1959, ended a career marked by long and loyal service to the National Crushed Stone Association.

In 1936, Mr. Ragland was elected to the Board of Directors of NCSA, and from 1938 until his retirement in 1950, he served as a Regional Vice President for the Southeastern Region.

As founder and chief executive of his own company until his retirement, Mr. Ragland's leadership was of a unique sort. Although a man of quiet forcefulness he shunned the spotlight preferring to work in the background and through others. To him personal credit was not important; it was the job and the achievement that counted. He will be greatly missed by those who knew him and by his many friends in the crushed stone industry. Surviving are his widow, Mrs. W. T. Ragland, Sr., his sons, W. M. Ragland, and W. Trent Ragland, Jr., President of the Superior Stone Co., Division of American-Marietta Co., and a sister, Mrs. E. R. Neff.

P R Through Employees

By ALFRED M. COOPER

THE importance of salesmen, receptionists and telephone operators as builders of goodwill has long been recognized. It is customary to train these people carefully in methods of meeting the public.

It sometimes takes a crisis to point up the tremendous effect of the day-by-day mingling of all employees with their friends and neighbors. A company may spend thousands of dollars in an honest effort to convince citizens of a community that it manufactures a superior product and its plant is "a good place to work."

But suppose a segment of that plant should at the same time, be telling their friends a different story? Will the public believe the favorable publicity of the company? Or will they attach more weight to the "inside information?"

It is surprising how the most enlightened company policy may become twisted into something detrimental to the interests of employees and townspeople alike. Just a few uninformed workers talking loosely, can inadvertently do a considerable amount of damage.

And it is not always the workers who say the wrong thing. In one large plant, a well equipped, new hospital unit was installed. Properly publicized, this facility should have been a real feather in management's cap.

But at a big dinner an executive of the company told the assembled crowd, "We've got a fine new hospital, staffed with two doctors and several nurses. With this splendid facility we now have no trouble handling 500 accident cases a day." Next day this information was featured in every newspaper in the city.

Phases of the Program

There are two phases to any program of public relations training for employees. First they must be informed about those important policies of management which can most favorably affect public attitude. Second, the employees must be taught how best to pass out this information.

The first requisite is that information given to employees for dissemination must be accurate. For best results, the employee should attend a conference where this information can be thoroughly discussed. After that, each worker should be furnished with printed matter for reference.

There is nothing like a discussion to fix pertinent facts in the mind. And discussion in a small conference group permits the leader to persuade those present that they have a responsibility in helping improve their company's public relations.

This latter objective is the more important one, since just issuing informative material to the employee has little value unless the worker will disseminate it. Hiring instructors to conduct these meetings is unnecessary. A better job can be done if each meeting is conducted by the immediate supervisor of the employees in attendance.

Instruction is a natural function of any supervisor, and employees are accustomed to look to their supervisor for new information. What's more, employees will usually accept the word of their supervisor that the information he is passing on to them is accurate.

At no time is it wise to employ coercion in persuading the workers to cooperate. Such tactics are never necessary, and certainly would fail.

At its inception, any such program is usually met with a certain amount of skepticism. This is a natural attitude, and employees must be convinced the program is legitimate. They must experience for themselves the satisfaction of being able to answer their acquaintances truthfully and authoritatively about their work.

Mechanics of Training

When management decides that certain information should reach the public through its employees, without possibility of its being garbled, and in a form that will insure its acceptance, the procedure is:

1. The supervisors who are to lead the discussion meetings are called together and the administrator of the program explains the purpose of the employee meetings.

2. With these supervisors he then leads a typical conference. At the close of this conference the supervisors discuss the material and the methods of presentation. Each is then furnished with a detailed conference plan for future reference, together with a schedule of meetings and the material that is to be issued at the employee meetings.

3. The round of employee meetings is held. In each meeting the information is discussed and the supervisor makes sure it is thoroughly understood by everyone present.

At the close of each conference the employees are requested by their supervisor to pass on this information to any citizen who may be interested.

In the years ahead occasions may well develop when employee understanding and cooperation may be vitally important. At such time it is well to be prepared to put a plantwide informative program of this type into effect.

[1] Condensed from *Manage* magazine, published by The National Management Association, Dayton 2, Ohio

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Asphalt Paving Machinery, Sand and Stone Dryers

Hewitt-Robins Incorporated

666 Glenbrook Road, Stamford, Conn.

Belt Conveyors (Belting and Machinery); Belt and Bucket Elevators; Car Shakeouts; Feeders; Industrial Hose; Screen Cloth; Sectional Conveyors; Skip Hoists; Stackers; Transmission Belting; Vibrating Conveyors, Feeders, and Screens; Design and Construction of Complete Plants; Molded Rubber Goods; Sheet Packing; Transmission Belting; Dewaterizers; Wire Conveyor Belts; Speed Reducers; Gears; Pulleys; Sheaves; Couplings

Hoyt Wire Cloth Co.

P. O. Box 1577, Lancaster, Pa.

Aggregate Wire Screens Made of Supertough, Abraso, and Stainless Steel Wire—Smooth-top, Longslot, Oblong Space, and Double Crimp Construction—For All Makes of Vibrators; Rubber Bucker Up Channel

Hughes Tool Co.

P. O. Box 2539, Houston 1, Texas

Bits—Rotary Rock

Ingersoll-Rand Co.

11 Broadway, New York 4, N. Y.

Rock Drills, Paving Breakers, Paving Breaker Accessories, Quarrymaster Drills, Drillmasters, Waterwell Drills, Down-Hole Drills, Crawl-ir Drills and Wagon Drills, Carset Bits, Jackbits, Bit Reconditioning Equipment, Portable and Stationary Air Compressors, Air Hoists, Slusher Hoists, Pneumatic Tools, Centrifugal Pumps, Diesel and Gas Engines

Insley Manufacturing Corp.

P. O. Box 167, Indianapolis 6, Ind.

1/2 to 1 Cu. Yd. Cranes and Shovels 5 to 35 Ton Capacity with Rubber or Crawler Mounting; Crane Mountings Including Trucks, Self-Propelled Rubber Tired Carriers and Crawlers; Concrete Buckets, Carts, Hoppers

International Harvester Co.
Construction Equipment Division

P. O. Box 270, Melrose Park, Ill.

Crawler Tractors and Equipment, Rubber Tired Scrapers and Bottom Dump Wagons, Off-Highway Dump Trucks, Carbureted and Diesel Power Units

Iowa Manufacturing Co.

916 16th St., N. E., Cedar Rapids, Iowa

Rock and Gravel Crushing, Screening, Conveying and Washing Plants, Asphalt Plants, Stabilizer Plants, Impact Breakers, Screens, Elevators, Conveyors, Portable and Stationary Equipment, Hammermills, Bins

Jaeger Machine Co.

550 West Spring St., Columbus 16, Ohio

Portable and Stationary Air Compressors, Self-Priming Pumps, Truck Mixers, Concrete Mixers, Road Paving Machinery, Hoists and Towers; Finishers—Concrete; Spreaders—Stone and Concrete, Truck Mixers—Concrete

Manufacturers Division – National Crushed Stone Association
(continued)

Jeffrey Manufacturing Co.

815 North Fourth St., Columbus 16, Ohio

Elevator Buckets; Car Pullers; Chains; Conveyors: Belt, Drag, Apron, Vibrating; Idlers; Crushers; Pulverizers; Elevators; Feeders; Pillow Blocks; Grizzlies; Screens

Joy Manufacturing Co.

333 Henry W. Oliver Bldg., Pittsburgh 22, Pa.

Drills: Blast-Hole, Wagon, Rock, and Core; Air Compressors: Portable, Stationary, and Semi-Portable; Aftercoolers; Portable Blowers; Carpullers; Hoists: Multi-Purpose and Portable; Rock Loaders; Air Motors; Trench Diggers; Belt Conveyors; "Spaders;" "String-a-Lite" (Safety-Lighting-Cable); Backfill Tampers; Drill Bits: Rock and Core; Joy Microdyne Dust Collectors

Kennedy-Van Saun Mfg. & Eng. Corp.

405 Park Ave., New York 22, N. Y.

Crushing, Screening, Washing, Conveying, Elevating, Grinding, Complete Cement Plants, Complete Lime Plants, Complete Lightweight Aggregate Plants, Synchronous Motors, Air Activated Containers for Transportation of Pulverized Material, Cement Pumps, and Power Plant Equipment

Kensington Steel
Division of Poor & Co., Inc.

505 East Kensington Ave., Chicago 28, Ill.

Oro Alloy and Manganese Steel Castings: For Shovels—Dipper Teeth, Crawler Treads, Rollers, Sprockets; For Crushers—Jaw Plates, Concaves, Mantles, Bowl Liners; For Pulverizers—Hammers, Grate Bars and Liners; For Elevators and Conveyors—Chain, Sprockets, Buckets; For Tractors—Rail Links, Sprocket Rims, and Grouser Plates; Drag Line Chain

Koehring Division
Koehring Co.

3026 West Concordia Ave., Milwaukee 16, Wis.

Excavating, Hauling, and Concrete Equipment

KW-Dart Truck Co.

1301 North Manchester Trafficway, Kansas City, Mo.

Off-Highway and Underground Heavy Duty Trucks

Link-Belt Co.

300 West Pershing Road, Chicago 9, Ill.

Complete Stone Preparation Plants; Conveyors, Elevators, Screens, Washing Equipment, and Power Transmission Equipment

Link-Belt Speeder Corp.

1201 Sixth St., S. W., Cedar Rapids, Iowa

Complete Line of Speed-o-Matic Power Hydraulically Controlled Cranes, Shovels; Hoes, Draglines, and Clamshells, 1/2 to 3-Yd. Capacities; Available on Crawler Base or Rubber Tire Mounting; Diesel Pile Hammers

Lippmann Engineering Works, Inc.

4603 West Mitchell St., Milwaukee 14, Wis.

Primary and Secondary Rock Crushers and Auxiliary Equipment such as Feeders, Screens, Conveyors, etc., Portable and Stationary Crushing and Washing Plants

Ludlow-Saylor Wire Cloth Co.

634 South Newstead Ave., St. Louis 10, Mo.

Woven Wire Screens of Ludloy (Oil Tempered); Super-Loy (Hi-Carbon); Steel; Stainless Steel; All Other Commercial Alloys

Mack Trucks, Inc.

1355 West Front St., Plainfield, N. J.

4- and 6-Wheeled Trucks and Tractors—Gasoline- and Diesel-Powered from 5 to 12 Cu. Yd. Capacity with a Wide Choice of Transmissions and Front and Rear Axles with 2-, 4-, and 6-Wheel Drives; 4- and 6-Wheeled Off-Highway Vehicles from 15- to 40-Ton Capacity with Diesel Power Plants Available from 170 to 400 Hp.

Manganese Steel Forge Co.

Richmond St. and Castor Ave.,
Philadelphia 34, Pa.

Rol-Man 11.00 to 14.00 Per Cent Rolled Manganese Steel Woven and Perforated Screens, and Fabricated Parts for Aggregate Handling Equipment

Marion Power Shovel Co.
Division of Universal Marion Corp.

617 West Center St., Marion, Ohio

Power Shovels, Draglines, Cranes, Truck Cranes—From 3/4 to 75 Yd.

Marsh, E. F., Engineering Co.

4324 West Clayton Ave., St. Louis 10, Mo.

Belt Conveyors

Manufacturers Division – National Crushed Stone Association
(continued)

Mayhew Supply Co., Inc.

4700 Scyene Road, Dallas 17, Texas

Blast Hole Drill Rigs

McLanahan & Stone Corp.

252 Wall St., Hollidaysburg, Pa.

Complete Pit, Mine, and Quarry Equipment—Crushers, Washers, Screens, Feeders, etc., Semi-Portable Plants

Meissner Engineers, Inc.

300 West Washington St., Chicago 6, Ill.

Engineers—Constructors—Specialists in Plant Layout, Construction-Engineering Design, Procurement, Construction Management, Quarry Surveys, Plant and Property Appraisals

Mercer Rubber Co.

136 Mercer St., Hamilton Square, N. J.

Belting—Conveyor, Elevator, and Transmission; Hose—Air, Water, Steam, Suction, Sandblast, Miscellaneous; Rubber Chute Lining

Monsanto Chemical Co.

800 North Lindbergh, St. Louis 66, Mo.

Prilled Ammonium Nitrate

Murphy Diesel Co.

5317 West Burnham St., Milwaukee 19, Wis.

Engines—Industrial Engine, and Power Units for Operation on Diesel and Dual Fuel Engines. Generator Sets, AC and DC from 64 to 165 Kw. Mech-Elec Unit—Combination Mechanical and Electric Power Furnished Simultaneously

New York Rubber Corp.

100 Park Ave., New York 17, N. Y.

Conveyor Belting: Stonore, Dependable, and Cameo Grades; Transmission Belting: Silver Duck Duroflex, Soft Duck Rugged, Commercial Grade Tractor

Nordberg Mfg. Co.

3073 South Chase Ave., Milwaukee 1, Wis.

Symons Cone Crushers, and Symons Gyratory and Impact Crushers; Gyradisc Crushers; Grinding Mills; Stone Plant and Cement Mill Machinery; Vibrating Screens and Grizzlies; Diesel Engines and Diesel Generator Units; Mine Hoists; Railway Track Maintenance Machinery

Northern Blower Co.

6409 Barberton Ave., Cleveland 2, Ohio

Dust Collecting Systems, Fans—Exhaust and Blower

Northwest Engineering Co.

135 South LaSalle St., Chicago 3, Ill.

Shovels, Cranes, Draglines, Pullshovels—Crawler and Truck Mounted

Olin Mathieson Chemical Corp.
Energy Division

East Alton, Ill.

Explosives, Blasting Caps, Blasting Accessories

Pennsylvania Crusher Division
Bath Iron Works Corp.

323 South Matlack St., West Chester, Pa.

Single Roll Crushers, Impactors, Reversible Hammermills, Ring Type Granulators, Kue-Ken Jaw Crushers, Kue-Ken Gyratories, Non-Clog and Standard One-Way Hammermills

Pettibone Mulliken Corp.

4710 West Division St., Chicago 51, Ill.

Tractor Shovels, Front End Loaders, Swing Loaders, Yard Cranes, Bucket and Fork Loaders, Motor Graders, Manganese Steel Castings, Material Handling Buckets, Clamshells, Draglines, Pull Shovel Dippers, Shovel Dippers, and Pumps

Pioneer Engineering
Division of Poor & Co., Inc.

3200 Como Ave., Minneapolis 14, Minn.

Jaw Crushers, Roll Crushers (Twin and Tripple), Impact Crushers, Hammer-Mills, Vibrating and Revolving Screens, Feeders (Reciprocating, Apron, and Pioneer Oro Manganese Steel), Belt Conveyors, Idlers, Accessories and Trucks, Portable and Stationary Crushing and Screening Plants, Washing Plants, Mining Equipment, Cement and Lime Equipment, Asphalt Plants, Mixers, Dryers, and Pavers

Pit and Quarry Publications, Inc.

431 South Dearborn St., Chicago 5, Ill.

Pit and Quarry, Pit and Quarry Handbook, Pit and Quarry Directory, Modern Concrete, Concrete Industries Yearbook, Equipment Distributor's Digest

Manufacturers Division – National Crushed Stone Association
(continued)

Porter, H. K., Co., Inc.
Thermoid Division

Tacony and Comly Sts., Philadelphia 24, Pa.

Conveyor Belts, Hose, and Packings

Productive Equipment Corp.

2926 West Lake St., Chicago 12, Ill.

Vibrating Screens

REICHdrill Division
Chicago Pneumatic Tool Co.

1439 Ash St., Terre Haute, Ind.

Rotary and "Down-the-Hole" Drilling Machines for Exploration, Coring, Blast Holes

Rock Products

79 West Monroe St., Chicago 3, Ill.

Publications: Rock Products and Concrete Products

Rogers Iron Works Co.

11th and Pearl Sts., Joplin, Mo.

Jaw Crushers, Roll Crushers, Hammermills, Vibrating Screens, Revolving Screens and Scrubbers, Apron Feeders, Reciprocating Feeders, Roll Grizzlys, Conveyors, Elevators, Portable and Stationary Crushing and Screening Plants, Mine Hoists, Drill Jumbos, Underground Loaders, Iron Castings, Screw Washers, and Classifying Tanks

Schramm, Inc.

West Chester, Pa.

Air Compressors: Portable and Stationary, Gasoline, Diesel, and Electric Driven; Boosters; Pneumatractors, Self-Propelled; Accessories; Bits—Rock: Rota-Tool Bits, Carbide Insert; Drills, Drilling Equipment: Rotadrills Mounted on Pneumatractors, Trucks and Crawlers; Ready-to-Mount Rotadrills for Mounting on Used Trucks and Crawler Tractors; Rotatools for Bottom-Hole Drilling; Rock Drills; Wagon Drills; Breakers; Accessories

Screen Equipment Co., Inc.

40 Anderson Road, Buffalo 25, N. Y.

Seco Vibrating Screens; Scales—Industrial, Aggregates, Truck

Simplicity Engineering Co.

Durand, Mich.

Simplicity Gyrating Screens, Horizontal Screens, Simpli-Flo Screens, Tray Type Screens, Heavy Duty Scalpers, D'Watering Wheels, D'Centegrators, Vibrating Feeders, Vibrating Pan Conveyors, Car Shake-Outs, Woven Wire Screen Cloth, Grizzly Feeders

SKF Industries, Inc.

P. O. Box 6731, Philadelphia 32, Pa.

Anti-Friction Bearings—Self-Aligning Ball, Single Row Deep Groove Ball, Angular Contact Ball, Double Row Deep Groove Ball, Spherical Roller, Cylindrical Roller, Ball Thrust, Spherical Roller Thrust; Tapered Roller Bearings; Pillow Block and Flanged Housings—Ball and Roller

Smith Engineering Works

532 East Capitol Drive, Milwaukee 12, Wis.

Gyratory, Gyrasphere, Jaw and Roll Crushers, Vibrating and Rotary Screens, Gravel Washing and Sand Settling Equipment, Elevators and Conveyors, Feeders, Bin Gates, and Portable Crushing and Screening Plants

Soiltest, Inc.

4711 West North Ave., Chicago 39, Ill.

Laboratory and Field Testing Apparatus: Drilling and Coring Rigs, Sieve Shakers, Sieves, Scales, Balances, Calibration Equipment, Abrasion Testing Machines, Ovens, Furnaces

Stardrill-Keystone Co.
Division of Koehring Co.

1100 Kenton St., Springfield, Ohio

Drilling Machines: Rotary Air Drills, Churn Drills, Rotary Tools, Rotary Bits, Down-the-Hole Guns, Insert Type Bits, and Water Well Drills

Stedman Foundry & Machine Co., Inc.

P. O. Box 209, Aurora, Ind.

Stedman Impact-Type Selective Reduction Crushers, 2-Stage Swing Hammer Limestone Pulverizers, Multi-Cage Limestone Pulverizers, Vibrating Screens

Stephens-Adamson Mfg. Co.

Ridgeway Ave., Aurora, Ill.

Belt Conveyors, Pan Conveyors, Bucket Elevators, "Amsco" Manganese Steel Pan Feeders, Vibrating Screens, Belt Conveyor Carriers, Bin Gates, Car Pullers, "Sealmaster" Ball Bearing Units, "Saco" Speed Reducers, and Complete Engineered Stone Handling Plants

Taylor-Wharton Co.
Division Harsco Corp.

High Bridge, N. J.

Manganese and Other Special Alloy Steel and Iron Castings; Dipper Teeth, Fronts and Lips; Crawler Treads; Jaw and Cheek Plates; Mantles and Concaves; Pulverizer Hammers and Liners; Asphalt Mixer Liners and Tips; Manganese Nickel Steel Welding Rod and Plate; Elevator, Conveyor, and Dredge Buckets; Pan Feeders

Manufacturers Division – National Crushed Stone Association
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Thew Shovel Co.

East 28th St. and Fulton Road, Lorain, Ohio

"Lorain" Power Shovels, Cranes, Draglines, Clamshells, Hoes. Scoop Shovels on Crawlers and Rubber Tire Mountings: Diesel, Electric, and Gasoline, 3/8 to 2 1/2 Yd. Capacities; Thew Motor-Loader—Rubber Tire Front End Loader 1 3/4 and 2 Yd. Capacity

Thor Power Tool Co.

175 North State St., Aurora, Ill.

Wagon Drills, Rock Drills, Sump and Sludge Pumps, Clay Diggers, Paving Breakers, Quarry Bars, Sinker Legs, Drifters, Rock Drilling Jumbos, Raiser Legs, Push Feed Rock Drills, Air and Electric Tools, Accessories, Generator Sets, Concrete Vibrators, Power Trowels, Vibratory Screeds

Torrington Co.
Bantam Bearings Division

3702 West Sample St., South Bend 21, Ind.

Anti-Friction Bearings; Self-Aligning Spherical, Tapered, Cylindrical, and Needle Roller; Roller Thrust; Ball Bearings

Tractomotive Corp.

County Line Road, Deerfield, Ill.

Rubber Tired Front End Loaders (Tracto-Loaders)

Traylor Engineering & Mfg. Co.

Allentown, Pa.

Stone Crushing, Gravel, Lime, and Cement Machinery

Trojan Powder Co.

17 North Seventh St., Allentown, Pa.

Explosives and Blasting Supplies

Tyler, W. S., Co.

3615 Superior Ave., N. E., Cleveland 14, Ohio

Woven Wire Screens; Ty-Rock, Tyler-Niagara and Ty-Rocket (Mechanically Vibrated) Screens; Hum-mer Electric Screens; Ro-Tap Testing Sieve Shakers, Tyler Standard Screen Scale Sieves, U. S. Sieve Series

Universal Engineering Corp.
Subsidiary of Pettibone Mulliken Corp.

625 C Ave., N. W., Cedar Rapids, Iowa

Crushers—Jaw, Roll, TwinDual Roll; Hammermills, Impact Breakers, Pulverizers, Bins, Conveyors, Feeders, Screens, Scrubbers. Bulldog Non-Clog Moving Breaker Plate and Stationary Breaker Plate Hammermills, Center Feed Hammermills. Complete Line of Stationary and Portable Crushing, Screening, Washing, and Loading Equipment for Rock, Gravel, Sand, Ore; Aglime Plants; Asphalt Plants

Vibration Measurement Engineers, Inc.

725 Oakton St., Evanston, Ill.

Seismographic and Airblast Measurements, Seismological Engineering, Blasting Complaint Investigations, Expert Testimony in Blasting Litigation; Complete Seismograph Rental and Record Analysis Service With "Seismolog"

Werco Steel Co.

2151 East 83rd St., Chicago 17, Ill.

Castings—Manganese, Alloy Steel; Screen Plates—Perforated Steel Screen Sections and Decks; Buckets; Chains; Belt Conveyors, Idlers; Dipper—Shovel; Drop Balls; Wire Cloth; Wire Rope and Related Products; Crushers, Pulverizers

Western-Knapp Engineering Co.

50 Church St., New York 7, N. Y.

Plant Design and Construction; Operating Studies; Appraisals

White Motor Co.

842 East 79th St., Cleveland 1, Ohio

On- and Off-Highway Trucks and Tractors—Gasoline- and Diesel-Powered; Industrial Engines—Gasoline and Diesel; Power Units, Axles, Special Machine Assemblies; Power Generating and Distributing Systems; Batteries; All Classes of Maintenance and Repair Service

White Motor Co.
Autocar Division

Exton, Pa.

Custom Engineered, Precision Built Trucks and Tractors for On- or Off-Highway: Gasoline or Diesel Powered, 2 or 3 Axles, Single Axle to All Axle Drives; Planetary Gear Driven Vehicles for Quarry, Mine, and Construction Operations

Wickwire Spencer Steel Division
Colorado Fuel and Iron Corp.

575 Madison Ave., New York 22, N. Y.

Wire Cloth, Screens, Screen Sections, Screen Plate—Perforated Steel, Wire Rope—Slings

Williams Patent Crusher & Pulverizer Co.

2701-2723 North Broadway, St. Louis 6, Mo.

Hammer Mills, Crushers, Pulverizers, Roller Mills, Reversible Impactors. Vibrating Screens, Air Separators, Bins, Feeders